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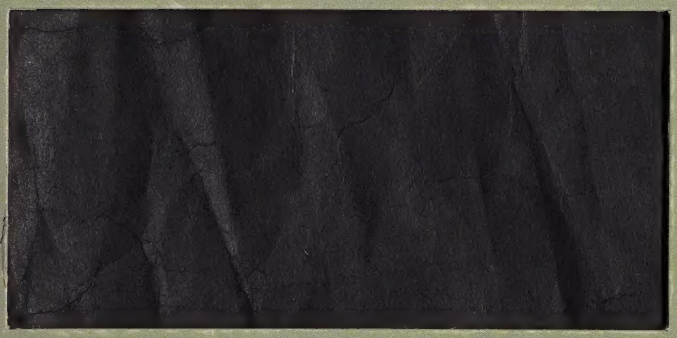

DANA™

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Publication
980439

PRELIMINARY MANUAL

MODEL 4800

DIGITAL VOLTMETER

DANA LABORATORIES, INC.
2401 CAMPUS DRIVE
IRVINE, CALIFORNIA 92664

DANA®

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January 1971

Warranty

Within one year of purchase, Dana Laboratories will repair or replace, at our option, your instrument if in any way it is defective in material or workmanship. All parts and labor charges will be paid by Dana Laboratories. Just return the instrument to your nearest authorized Dana Service Center freight prepaid. We will return it to you freight prepaid.

DANA

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SECTION 1

INTRODUCTION

1.1 GENERAL DESCRIPTION.

1.2 The Dana Model 4800 Digital Voltmeter is a four-digit instrument with a fifth decade providing 100% overrange on all functions except AC (700V RMS max.) and DC (1000V max.).

1.3 The instrument (with accessories) measures DC volts, DC millivolts, Ohms, AC volts, and ratios. Both manual and automatic ranging are provided. In Autorange, the instrument upranges at 200% of full scale and downranges at 10% of full scale. Polarity selection is automatic and is displayed on the readout.

1.4 Two operating modes are provided. In Single Read mode, a reading is held until a single reading is commanded by a front panel pushbutton switch. That reading is then held until the switch is again activated. In Periodic mode, readings are taken automatically at the rate of three and one-third per second.

1.5 A Program Control switch on the front panel places the instrument under remote control in which all commands are received through the program input connector. A BCD output is provided to an external printer or other output device.

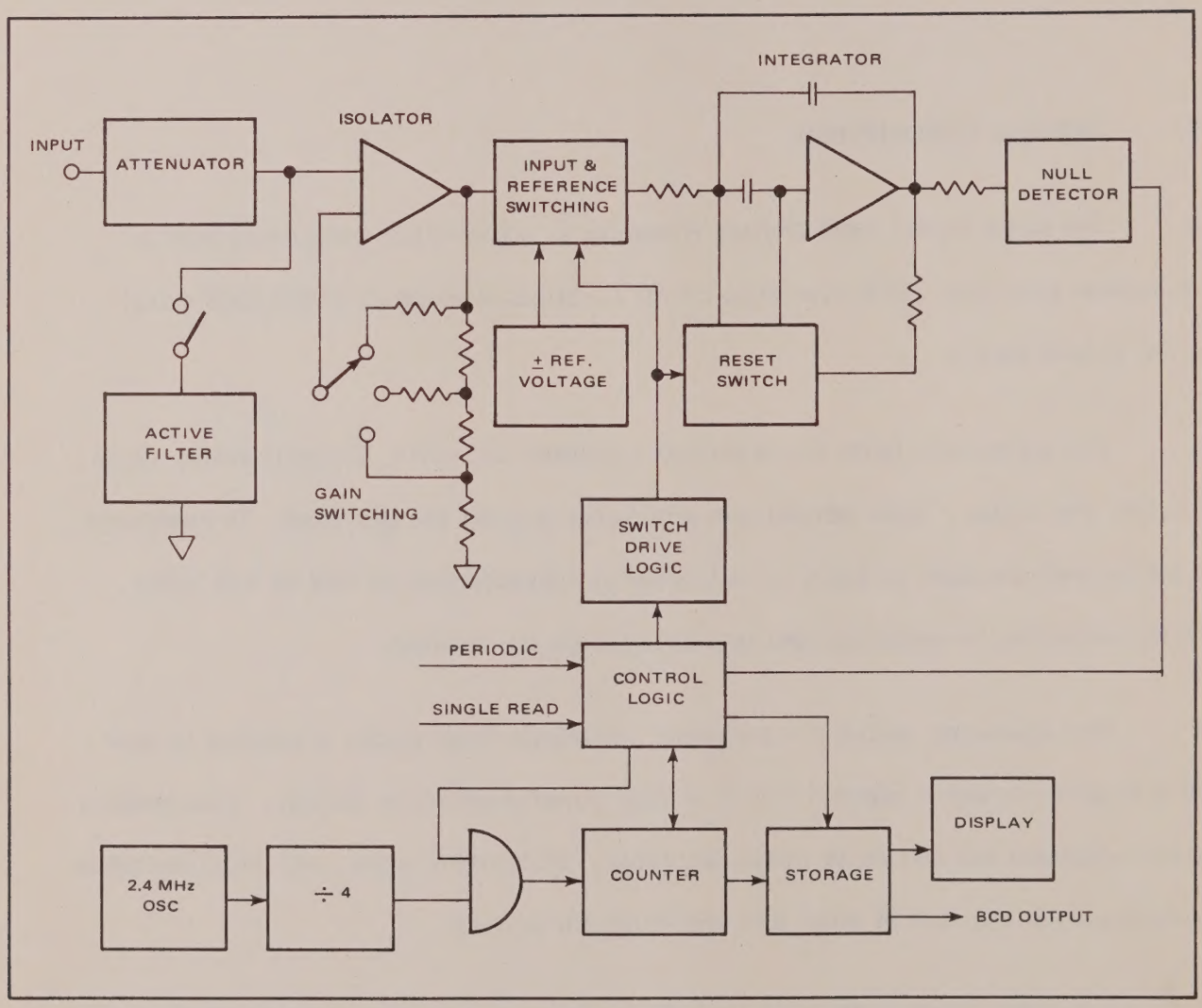


Figure 1.2 - Block Diagram

1.6 ELECTRICAL DESCRIPTION.

1.7 A block diagram of the Model 4800 is shown in figure 1.2. A dc input signal is applied through the attenuator (voltage divider) to the Isolator amplifier. Ranging is accomplished by the voltage division of the attenuator combined with the gain of the Isolator. The Isolator output is a ten-volt full scale (20 volts in overrange) analog voltage representing the input.

1.8 For AC measurements, the signal is first applied to the AC Converter where it is scaled, rectified, and filtered. The resulting d-c voltage is then applied to the attenuator and measured as DC.

1.9 To measure resistance, an Ohms Converter is used. The Ohms Converter generates a current that is applied to the unknown resistance. A voltage, representing a ratio $(\frac{E_x}{E_{FS}})$ of the voltage drop across the unknown resistor (E_x) to the voltage drop across a "full-scale" resistor (E_{FS}) is measured as a dc ratio and displayed in ohms.

1.10 The analog output of the Isolator is converted to its digital equivalent by the Integrator using the dual-slope technique. Figure 1.3 shows a simplified Integrator circuit and the dual slope produced.

1.11 I_S and I_R, shown as current generators, represent current derived from the signal (I_S) and the reference current generated within the instrument (I_R). Both constant currents, they are applied to integrator capacitor C_i as the appropriate switch is closed.

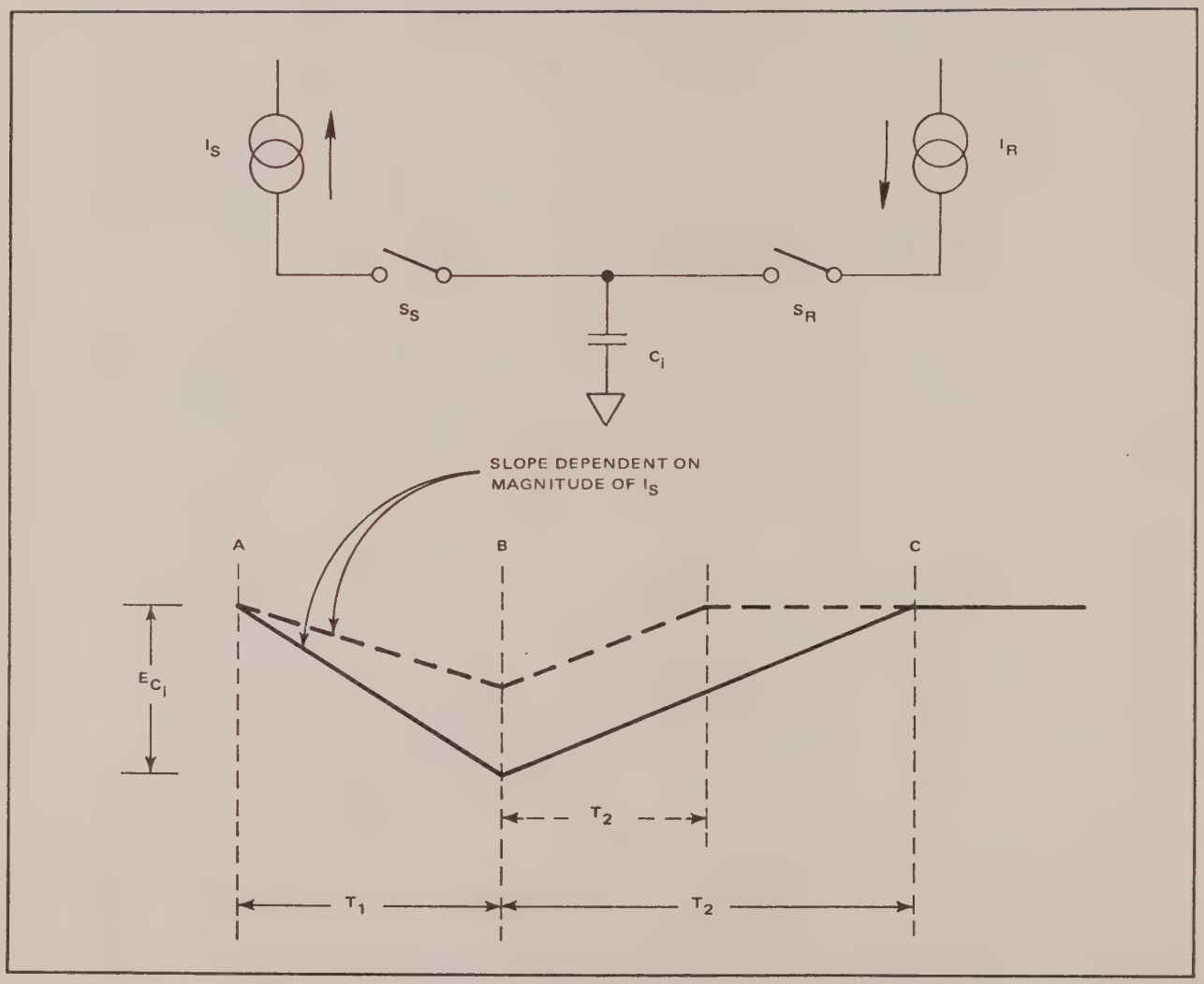


Figure 1.3 - Simplified Integrator Circuit

1.12 Period T1 is the signal integration period. At time A, S_S closes and C_i (initially charged) begins to discharge. T1 is a fixed period. At time B, S_S opens and S_R closes starting the reference integration period (T2). C_i charges at a constant rate. The time required to charge the capacitor to zero is proportional to the voltage across the capacitor at the end of the signal integration period; therefore, it is proportional to the input.

1.13 A counter operates during the integration period at a rate of 600 KHz. The counter output is stored in Storage IC's. The counter is stopped when the reference integration ramp reaches zero by a pulse from the Null Detector. The contents of the Storage circuits are then displayed and routed to the BCD output circuitry.

1.14 The Control Logic (figure 1.2) generates control signals that operate the Integrator switches at the appropriate time.

Table 1.1 - Model 4800 Specifications

GENERAL

Ranging:	Automatic or Manual
Outputs False True	 0V to .5V 2.4V to +5V
Integration Time:	16-2/3 ms
Maximum Common Mode Voltage:	500V guard to case with logic common connected to case; 250V Analog common to guard
Maximum Power Requirement:	115V ± 10%, 50 - 400 Hz, 40 watts 220/240V optional
Operating Temperature:	0° to 50°C
Warmup:	30 minutes to full accuracy
Dimensions:	17 x 3-1/2 x 14 inches
Weight:	16 pounds
Guarantee:	12 months, faulty workmanship or component failure

DC

Full Scale Ranges:	100 mV, 1V, 10V, 100V, 1000V
Resolution:	.01% of range; 10 μV on .1V range

Table 1.1 - Model 4800 Specifications (Continued)

DC (Continued)

Accuracy:	
24 Hours	23°C ± 1°C: ± .005% reading ± .005% f.s.
90 days	23°C ± 5°C: ± .01% reading ± .01% f.s.
Polarity:	Automatic bi-polar
Input Impedance:	Filter Out
.1V range:	>10,000 MΩ
1V range:	>10,000 MΩ
10V range:	>10,000 MΩ
100V range:	10 MΩ
1000V range:	10 MΩ
	Filter In
.1V, 1V, and 10V range:	>10,000 MΩ Shunted by 100 KΩ in series with .3 μF
100V and 1000V range:	10 MΩ ± 1%
Normal Mode Noise Rejection:	Filter Out: 48 dB at every multiple of 60 Hz Filter In: 48 dB at 59 Hz 100 dB at 300 Hz and above
Common Mode Noise Rejection:	
Filter Out, 100Ω unbalance:	140 dB at DC 120 dB, 61 Hz and below plus 48 dB at every multiple of 60 Hz
Filter In, 100Ω unbalance:	140 dB at DC 126 dB, 61 Hz to 100 KHz
Response Time:	Settles to .01% in 5 msec with 10K source
Maximum Voltage Rating (any range):	1000 Volts DC or peak AC

Table 1.1 - Model 4800 Specifications (Continued)

DC/MV

Full Scale Ranges:	10 mV, .1V, 1V, 10V, 100V, 1000V
Resolution:	.01% range; 1 μV on 100 mV range
Accuracy:	
24 Hours, 23°C ± 1°C (after zeroing)	10 mV range: ± .005% reading ± .02% f.s.
	.1V, 1V, 10V, 100V and 1000V range: ± .005% reading ± .005% f.s.
90 days, 23°C ± 5°C (after zeroing)	10 mV range: ± .01% reading ± .05% f.s.
	.1V, 1V, 10V, 100V, and 1000V range: ± .01% reading ± .01% f.s.
Polarity:	Automatic Bi-polar
Input Impedance	
Filter Out:	10,000 MΩ all ranges
Filter In:	
10 mV, .1V range:	>10,000 MΩ
1V, 10V range:	>10,000 MΩ shunted by 100KΩ in series with .3 μF
100V, 1000V range:	10 MΩ ± 1%
Normal Mode Noise Rejection:	Same as DC
Common Mode Noise Rejection:	Same as DC
Response Time:	Same as DC
Maximum Voltage:	
10 mV, .1V range:	150V DC or RMS
1V, 10V, 100V, 1000V range:	1000V DC or peak AC

Table 1.1 - Model 4800 Specifications (Continued)

RATIO

Full Scale Ranges:	Same as selected function
Polarity:	Automatic Bi-polar
Reference Voltage Polarity:	Positive only
Reference Voltage Range:	DC, AC, DC/MV: + 1V to 10.5V Ohms: +9V to 10.5V
Maximum Function Voltage:	Same as Function
Reference Input Impedance:	100 Megohms
Reference Normal Mode Rejection:	15 dB at 60 Hz increasing a 6 dB/octave to 100 dB at 1 MHz
Reference Input Bias Current:	250 na
Reference Settling Time: (to .01%)	.25 sec
Accuracy:	
24 Hours, 23°C ± 1°C	DC and MV/DC all ranges but 10 mV: (± .005% reading ± .005% f.s.) x $(\frac{10V}{Ref})$ 10 mV range: (± .005% reading ± .01% f.s.) x $(\frac{10}{Ref})$ Ohms: 1 Ω range: (± .005% reading ± .02% f.s.) x $(\frac{10V}{Ref})$ 10 Ω to 10 MΩ range: (± .005% reading ± .005% f.s.) x $(\frac{10V}{Ref})$ 10 MΩ range: (± .01% reading ± .01% f.s.) x $(\frac{10V}{Ref})$

Table 1.1 - Model 4800 Specifications (Continued)

KILOHMS

Full Scale Ranges:	1Ω , 10Ω , .1 KΩ , 1 KΩ , 10 KΩ , 100 KΩ , 1000 KΩ , 10 MΩ , 100 MΩ
Type:	4 wire
Accuracy:	
24 Hours, 23°C ± 1°C	1Ω range: ± .005% reading ± .02% f.s.
	10Ω to 10 MΩ range: ± .005% reading ± .005% f.s.
	100 MΩ range: ± .01% reading ± .01% f.s.
90 days, 23°C ± 5°C	1Ω range: ± .01% reading ± .05% f.s.
	10Ω to 1 MΩ range: ± .01% reading ± .01% f.s.
	10 MΩ range: ± .05% reading ± .01% f.s.
	100 MΩ range: ± .2% reading ± .01% f.s.
Response Time:	1Ω to 10 MΩ 20 msec
	100 MΩ : 200 msec
Current Through Unknown:	
1Ω , 10Ω range	10.1 ma
100Ω range	1.01 ma
1 kilohm range	.101 ma
10 kilohm range	1 ma
100 kilohm range	.1 ma
1 megohm range	.01 ma
10 MΩ range	1 μa
100 MΩ range	.1 μa
Fault Voltage:	30V peak AC or DC on any range

Table 1.1 - Model 4800 Specifications (Continued)

AC

Full Scale Ranges:	.1V, 1V, 10V, 100V, 1000V
Type:	Distortion Insensitive (DIAC) Converter
Resolution:	.01% of range
Maximum Input Voltage:	750V RMS to 20 KHz, decreasing linearly to 20V at 1 MHz; Frequency X E_{in} < 2 x 10^7 volt-Hz
Settling Time: (to .1% of final value)	350 msec
Input Impedance Front Input terminals (+IN to -IN Terminal):	1 megohm (±.1%) in series with .22 µF capacitor, shunted by less than 100 pF to common
Common Mode Rejection: DC to 60 Hz (100 Ω Source)	
.1V range	120 dB
1V range	120 dB
10V range	100 dB
100V range	80 dB
1000V range	60 dB
	(CMR is referred to Input full scale)
Temperature Coefficient: (Sine wave input)	
30 Hz to 100 KHz	
.1V range	± .004% rdg ± .010% f.s./°C
1V, 10V, 100V, 1000V range	± .003% rdg ± .002% f.s./°C
100 KHz to 1 MHz	
.1V, 1V, 10V, 100V, 1000V range	± .01% rdg ± .01% f.s./°C

Table 1.1 - Model 4800 Specifications (Continued)

AC (Continued)

Accuracy:	
24 Hours, 23°C ± 1°C .002V < E_{IN} < 500V Sine Wave Input (after offset adjust)	
30 Hz to 50 Hz	.1V range: ± .10% reading ± .08% f.s. 1V, 10V, 100V, 1000V range: ± .10% reading ± .01% f.s.
50 Hz to 20 KHz	.1V range: ± .02% reading ± .08% f.s. 1V, 10V, 100V, 1000V range: ± .02% reading ± .01% f.s.
20 KHz to 100 KHz	.1V range: ± .03% reading ± .10% f.s. 1V, 10V, 100V, 1000V range: ± .03% reading ± .02% f.s.
100 KHz to 300 KHz	.1V range: ± .25% reading ± .25% f.s. 1V, 10V, 100V, 1000V range: ± .25% reading ± .07% f.s.
300 KHz to 1 MHz	.1V range: ± .5% reading ± .5% f.s. 1V, 10V, 100V, 1000V range: ± .5% reading ± .1% f.s.
90 days, 23°C ± 5°C	.1V range: Add ± .03% reading ± .03% f.s. to 24 Hour specification 1V, 10V, 100V, 1000V range: Add ± .01% reading ± .01% f.s. to 24 Hour specification

Table 1.1 - Model 4800 Specifications (Continued)

AC (Continued)

6 months, 23°C ± 5°C	.1V range: Add ± .04% reading ± .03% f.s. to 24 Hour specification 1V, 10V, 100V, 1000V range: Add ± .02% reading ± .01% f.s. to 24 Hour specification
Shunt Capacitance: Rear Input Option (+IN to -IN Terminal)	120 pF

SECTION 2

INSTALLATION & OPERATION

2.1 UNPACKING AND INSPECTION.

2.2 The Model 4800 DVM is secured in four molded, plastic-foam forms and packaged in a double-walled cardboard carton for shipment. The plastic forms hold the DVM securely in the carton and absorb any reasonable external shock normally encountered in transit. Prior to unpacking, examine the exterior of the shipping carton for any signs of damage. Carefully remove the DVM from the carton and inspect the exterior of the instrument for any signs of damage. If damage is found, notify the carrier immediately.

2.3 POWER CONNECTIONS.

2.4 A standard, eight-foot, three-wire power cable is supplied with the instrument. It connects to the POWER connector on the rear panel.

2.5 A .5 amp line fuse is mounted on the rear panel of the instrument.

2.6 Instruments for export, designated as 4800E, are equipped with a special transformer and jumper matrix, allowing the user to adapt the instrument for operation on various line voltages. In figure 2.1 is shown the proper jumper placement on the power matrix board for each line voltage. The matrix board assembly is mounted directly to the power transformer.

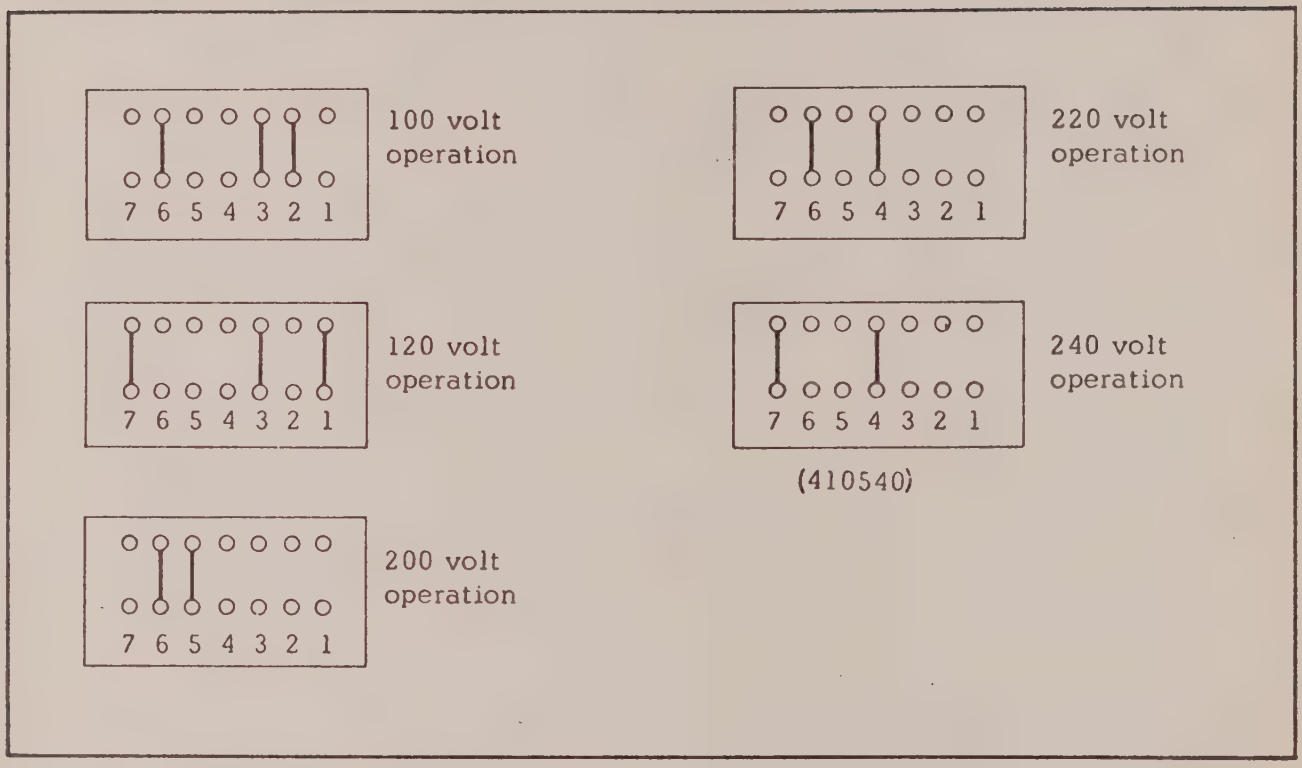

100 volt operation
7 6 5 4 3 2 1
220 volt operation
7 6 5 4 3 2 1
120 volt operation
7 6 5 4 3 2 1
240 volt operation
7 6 5 4 3 2 1
(410540)
200 volt operation
7 6 5 4 3 2 1

Figure 2.1 - Power Transformer Taps

2.7 CONTROLS.

2.8 The POWER switch, on the front panel, applies power to the instrument when ON. The OFF position removes power from all portions of the instrument. Other controls are described in table 2.1.

Table 2.1 - Front Panel Switches

Switch	Position	Function
Function Select (rotary switch)	AC	Selects the measurement of AC voltages on the .1, 1, 10, 100, and 1000 volt ranges (max. input, 700V RMS)
	DC	Selects the measurement of DC voltages on the .1, 1, 10, 100, and 1000 volt ranges (max. input, 1000V)
	mV - DC	Selects the measurement of DC voltages on the 10 mV range plus the five d-c ranges (above)
	Ω - MΩ	Selects the measurement of resistance on the 1 and 10 ohm ranges; on the .1, 1, 10, 100, and 1000 Kilohms ranges; or on the 10 or 100 Megohm ranges
Range Select (rotary switch)	AUTO	Selects Auto Range in which the optimum range is selected automatically by internal circuits. Uprange occurs at 200% of full scale; Downrange occurs at 10% of full scale
	Other Positions	Enables manual selection of fixed ranges. Ranges permissible for each function are inscribed on the panel
DATA OUTPUT (pushbutton)	Depressed	Enables the print pulse causing BCD data at P202 to be recorded by printer, or other output device. (Output data is present at P202 regardless of the position of this switch.)
PROGRAM CONTROL (pushbutton)	Depressed	Enables the selection of range, function, and mode to be made externally through the remote programming connector
PERIODIC (pushbutton)	Depressed	Selects the Periodic mode of operation in which the instrument automatically takes readings at the rate of 3-1/3 per second (approx.)

Table 2.1 - Front Panel Switches (Continued)

Switch	Position	Function
HOLD (pushbutton)	Depressed	Selects the HOLD mode in which each reading is held until a new reading is commanded by depression of the SINGLE switch or by an external read command
SINGLE (momentary-contact pushbutton)	Depressed	Commands a new reading to be taken in HOLD mode. Only one reading is taken and held until SINGLE is again depressed (NOTE: DVM will not Auto Range in Single Read mode.)
RATIO (pushbutton)	Depressed	Selects a ratio measurement in which the readout represents the ratio of the input to an external reference voltage (applied at terminals on the rear panel) multiplied by 10: $\frac{E_{in}}{E_{Ref}} \times 10$
FILTER (pushbutton)	Depressed	Adds an active three-pole filter across the input circuit when measuring any function but AC. In AC mode, filter is switched in automatically
FRONT/REAR (slide switch on Model 4800-1 only)	Front	Selects signal at front set of input terminals for measurement
	Rear	Selects signal at rear set of input terminals for measurement

2.9 INPUT CONNECTIONS.

2.10 Signal input binding posts are located on the front panel of the instrument. Connections to these terminals are made with standard "banana" plugs on the input cable. Instruments designated as 4800-1 are equipped with a duplicate set of input terminals on the rear panel. The input may be connected to either set of terminals. Pin assignment of the rear input connector is shown in table 2.2.

Table 2.2 - Pin Assignment, Rear Input Connector*

Pin	Function
2	Guard
3	- Input
4	- Current
6	+ Current
7	+ Input
Connector: Viking TKR7-101 (Dana 600673)	
Mating Connector: Viking TKP7-100 (Dana 600616)	

2.11 EXT REF terminals (binding posts) on the rear panel are the inputs for an external reference voltage used in ratio measurements.

2.12 ANALOG OUTPUT terminals (binding posts) on the rear panel deliver a scaled and buffered 0 to ± 20V dc (including overrange) voltage equivalent of the readout. This output can be used to drive a recorder or as an accurate (.02%) voltage source. Output current is 1 ma, maximum.

2.13 OPERATING INSTRUCTIONS.

2.14 For basic DC, mV, or AC measurement, a single-conductor shielded cable is used for interconnection between the signal source and the DVM. The conductor carries the high side of the signal and connects to the + INPUT terminal. The shield connects to the - INPUT terminal which is strapped to GUARD. (See figure 2.2.)

*NOTE: To remove the mating connector from the rear input, grasp the connector with a finger on each of the two knurled areas of the connector (top and bottom). Squeeze firmly to release lock and pull.

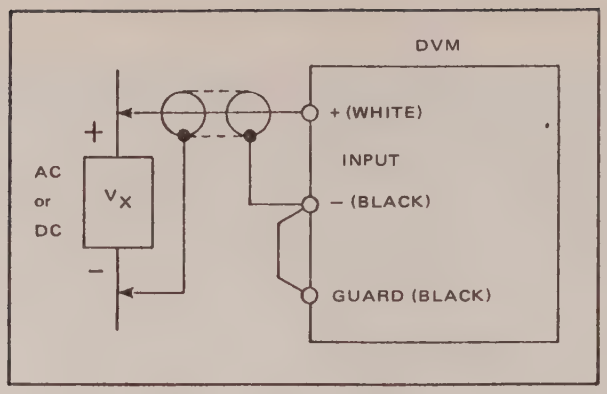


Figure 2.2 - Basic Measurement Connection

2.15 Where common-mode signals are present, a two-conductor shielded cable is required. Connections are made as shown in figure 2.3. The signal input terminals are isolated from the digital section and from power ground.

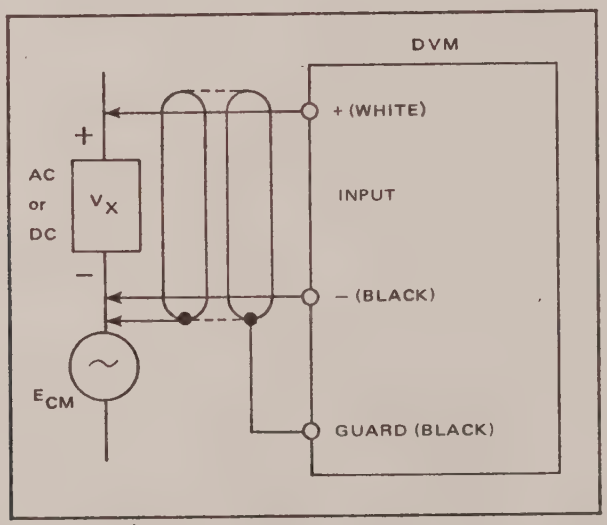


Figure 2.3 - Connections Where CM Present

2.16 For Resistance measurement, connect leads to the unknown resistance as shown in figure 2.4.

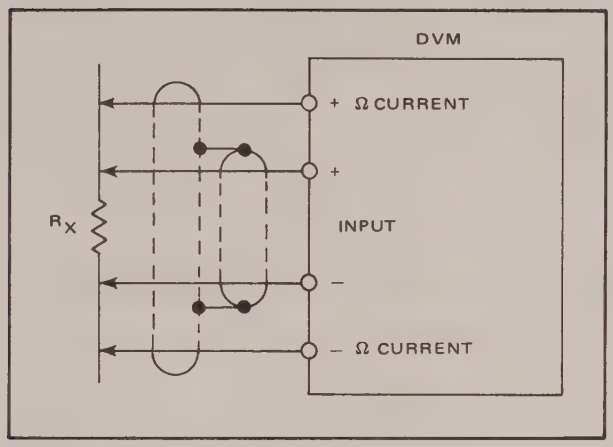


Figure 2.4 - Connections for Resistance Measurement

2.17 Ratio measurements are made by applying a positive d-c voltage to the reference input terminals on the rear panel and an input signal of any function at the front input terminals. For DC/DC, DC-MV/DC, or AC/DC ratios, the reference voltage must be within the range of +.5V to +10.5V. For Ω/DC ratio, the reference voltage must be within +9V to +10.5V. Input voltage limitations (numerator) are the same as those given for conventional measurement of the particular function. The readout is the ratio multiplied by ten: $E_{input}/E_{reference} \times 10$.

2.18 The - INPUT terminal is internally connected to the - REF input terminal.

2.19 Once the instrument has been connected to the power line and to the signal source in accordance with the instructions, the operator can make all required measurements by setting controls as described in table 2.1.

CAUTION

Do not exceed the following maximum inputs:

DC	1000 VDC or peak AC
DC/mV	On 10 mV and .1 volt range: 150 VDC or RMS AC On 1V, 10V, 100V, and 1000V ranges: 1000 VDC or peak AC
AC	750V RMS to 20 KHz decreasing to 200V RMS at 100 KHz
RATIO	input: same as function selected reference: +10.5V
OHMS	With + OHMS CURRENT terminal connected to + INPUT: 1Ω to 10KΩ ranges: -30V/+150V DC or peak AC 100KΩ to 100MΩ ranges: ± 150V DC or RMS AC with + OHMS CURRENT terminal floating (from input): ± 150V DC or RMS AC

2.20 The DVM has 100% overrange capability in all functions except the 1000 range on AC and DC. Maximum AC input is 750V RMS; maximum DC input is 1000 volts. On any range, an overrange condition is indicated by the maximum readout of 20000 and illumination of the NO indicator on the readout. The NO indicator also lights if a function or range is selected for which the DVM is not equipped.

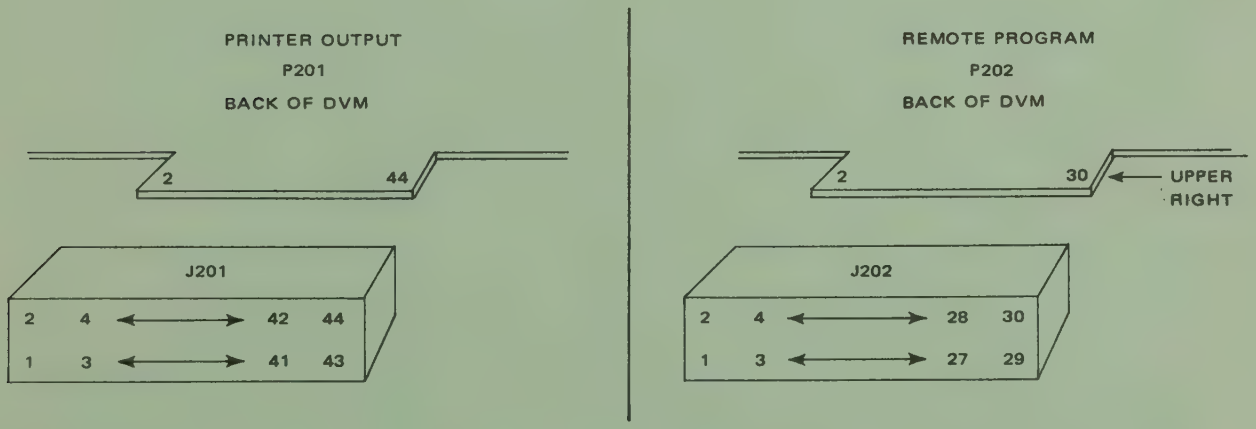
SPECIAL NOTE

PRINTER OUTPUT AND REMOTE PROGRAM CONNECTORS.

On some instruments, the output and program connectors are not keyed; it is possible to connect them improperly. For proper orientation of the connectors, install mating connectors as described below.

Printer Output (J201). Mating connector must be installed so that pin 44 mates with the upper right-hand pin of P201 (when viewing the DVM from the rear).

Remote Program (J202). Mating connector must be installed so that pin 30 mates with the upper right-hand pin of P202 (when viewing the DVM from the rear).



2.21 BCD OUTPUT.

2.22 Output data is delivered to the Printer Output Connector P201 in 8-4-2-1 BCD code at standard TTL logic levels:

False = 0V to +.5V

True = +2.4V to +5V

Maximum "fanout" = 2

Maximum Capacitive Load = 500 pF

2.23 All outputs are referenced to data output ground (pin 22). This ground may be floated at up to 200V (peak) from power ground. Table 2.3 lists the pin assignments of P201. The connector is double-edged.

> CAUTION
>
> True output lines are not short-circuit proof. Accidental grounding may damage the output circuitry.

2.24 DATA OUTPUT.

2.25 Data output is delivered on 18 lines in positive true format. Table 2.3 identifies each output by decade and BCD weight (pins 29 - 44). Polarity is indicated on pins 28 (-) and 26 (+) in positive true levels. Pin 27, $10K_1$, is true to indicate a "1" in the most-significant digit (10K); pin 25, $10K_2$, is true to indicate a "2".

2.26 FUNCTION OUTPUT.

2.27 Function outputs appear in negative true format on six pins: $\overline{DC/MV}$ (pin 19), $\overline{Ratio}$ (pin 17), $\overline{Filter}$ (pin 15), $\overline{DC}$ (pin 13), $\overline{Ohms}$ (pin 11), and $\overline{AC}$ (pin 9).

Table 2.3 - Printer Output Connector

	PIN		
10_1	44	43	$1K_1$
10_8	42	41	$1K_8$
10_2	40	39	$1K_2$
10_4	38	37	$1K_4$
1_1	36	35	100_1
1_8	34	33	100_8
1_2	32	31	100_2
1_4	30	29	100_4
- Polarity	28	27	$10K_1$
+ Polarity	26	25	$10K_2$
$\overline{DVM\ Command}$	24	23	PRINT
Ground	22	21	NO
$\overline{Hold}$	20	19	$\overline{DC/MV}$
+5V	18	17	$\overline{Ratio}$
B_0	16	15	$\overline{Filter}$
A_0	14	13	$\overline{DC}$
C_0	12	11	$\overline{\Omega}$
D_0	10	9	$\overline{AC}$
	8	7	
	6	5	
	4	3	
	2	1	
Connector Type: Cinch 50-44C-10			

2.28 RANGE OUTPUT.

2.29 Range identification is given in four-line BCD code in positive true format according to table 2.4.

Table 2.4 - Range Codes

Range	A (pin 14)	B (pin 16)	C (pin 12)	D (pin 10)	BCD
1 Ω	1	0	0	0	1
10 Ω , 10 mV	0	1	0	0	2
.1 KΩ , .1V	1	1	0	0	3
1 KΩ , 1V	0	0	1	0	4
10 KΩ , 10V	1	0	1	0	5
100 KΩ , 100V	0	1	1	0	6
1000 KΩ , 1000V	1	1	1	0	7
10 MΩ	0	0	0	1	8
100 MΩ	1	0	0	1	9

2.30 DVM COMMAND.

2.31 In the absence of the Programming option, DVM Command (pin 24) is used to command a reading. The command is automatically delayed 5 msec ± 20% to allow for input settling time and digitizer reset. The command occurs on the positive TTL transition. Specifications for command pulse are shown in figure 2.5.

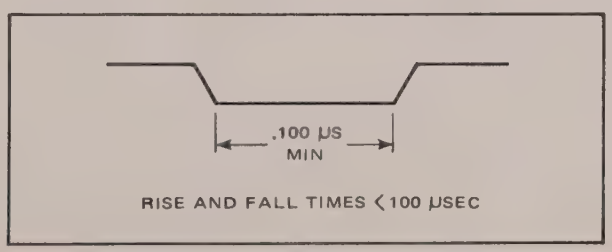


Figure 2.5 - DVM Command Pulse

2.32 PRINT PULSE.

2.33 The Print pulse (pin 23) remains true during the signal and reference integration periods plus the overrange period, if any. It drops to false to indicate to the printer that the reading is complete and can be printed.

2.34 "NO" Indication.

2.35 The "NO" line (pin 21) duplicates the "NO" indicator on the readout. An overrange condition is indicated by a true "NO" line and data output of 20000. The line is also true if a function or range is selected for which the instrument is not equipped.

2.36 REMOTE PROGRAMMING.

2.37 The DVM receives commands through program input connector J202 on the rear panel. Pin assignments of P202 are listed in table 2.5. Commands are made by a switch closure from the selected command to ground (pin 25) or by standard TTL logic levels (0 to .4V, false; +2.4 to +5.0V, true) with respect to ground.

2.38 Function Programming. Function is selected by applying a ground or false logic level to the appropriate pin:

DC	pin 14
DC/MV	pin 19
AC	pin 26
OHMS	pin 24
RATIO	pin 22
FILTER	pin 20

NOTE: When programming $\overline{\text{AC}}$ function and AUTORANGE, FILTER-pin 20, must also be selected to obtain proper timeout. This is not necessary when a fixed range is programmed.

2.39 Range Programming. The range, except for Autorange, is programmed by applying a positive true BCD code to the four range lines (pins 12, 15, 17, and 18) according to the following table. Autorange is selected by a ground or false logic level applied to pin 16.

Range	Range A pin 12	Range B pin 18	Range C pin 15	Range D pin 17
1 ohm	1	0	0	0
10 ohms, 10 mV	0	1	0	0
.1 Kilohm, .1V	1	1	0	0
1 Kilohm, 1V	0	0	1	0
10 Kilohm, 10V	1	0	1	0
100 Kilohms, 100V	0	1	1	0
1 Megohm, 1000V	1	1	1	0
10 Megohms	0	0	0	1
100 Megohms	1	0	0	1

Table 2.5 - Program Input Connector P202

	PIN		
Remote (Output Flag)	30	29	$\overline{\text{Ext DVM Command (FAST)}}$
$\overline{\text{Ext Hold}}$	28	27	$\overline{\text{Ext DVM Command (Timeout)}}$
$\overline{\text{Ext AC}}$	26	25	Ground
$\overline{\text{Ext } \Omega}$	24	23	+5 Volt
$\overline{\text{Ext Ratio}}$	22	21	$\overline{\text{Ext Program Control}}$
$\overline{\text{Ext Filter}}$	20	19	$\overline{\text{Ext DC/MV}}$
Ext B in	18	17	Ext D in
Ext $\overline{\text{AUTO}}$	16	15	Ext C in
Ext $\overline{\text{DC}}$	14	13	
Ext A in	12	11	

(Continued)

Table 2.5 - Program Input Connector P202 (Continued)

	PIN		
Not Used	10	9	Not Used
Not Used	8	7	Not Used
Not Used	6	5	Not Used
Not Used	4	3	Not Used
Not Used	2	1	Not Used
Connector Type: Cinch 50-30C-10			

2.40 $\overline{\text{Ext Program Control}}$. A contact closure to ground or a false logic level to pin 21, $\overline{\text{Ext Program Control}}$, disables all front panel controls. Operation of the DVM is then under control of the remote program input.

2.41 Remote (Output Flag). Remote (Output Flag), pin 30, is an output line that remains at true logic level while the DVM is under remote control.

2.42 +5 Volts. A voltage of 5 volts $\pm$ 5% from the logic power supply is available for systems use. Current output is .1 amp, maximum.

2.43 Read Commands. Either of two read command lines can be selected by a contact closure to ground or by a negative logic level transition. Pin 29, Fast Command, starts a new measurement after a 5 msecond reset delay. Pin 27, Timeout Command, starts a new measurement after a Timeout delay to allow for settling time of the measured signal (in addition to the 5 msec basic delay). Timeouts for the various functions are listed in the following table. In Autorange, the indicated delays are taken following each range change.

Function	Timeout
DC	30 msec
1 ohm to 10 Megohm	300 msec
100 Megohm	300 msec
Filter	250 msec (plus function timeout)
AC*	500 msec

*See note on page 2-12.

SECTION 3

CALIBRATION

3.1 EQUIPMENT REQUIRED.

a. Precision DC Voltage Standard (Fluke 332A or equivalent)

b. AC Lab Power Source (HP 745A and HP 746A or equivalent)

c. Microvoltmeter (Fluke 845A or equivalent)

d. Standard Resistors:

100 MΩ
19 MΩ
1.9 MΩ
190 KΩ
19 KΩ
1.9 KΩ
190Ω
19Ω
1.9Ω

NOTE: All adjustment locations are shown in figure 3.2.

3.2 Isolator Voltage Zero (Figure 3.1).

a. Set RANGE to .1; FUNCTION to DC; FILTER out.

b. Short point (1) to ground (front panel - INPUT terminal).

c. Connect microvoltmeter across point (1) and point (2) .

d. Adjust R36 (figure 3.5) for a voltage of less than 10 µvolts on the microvoltmeter. Remove microvoltmeter.

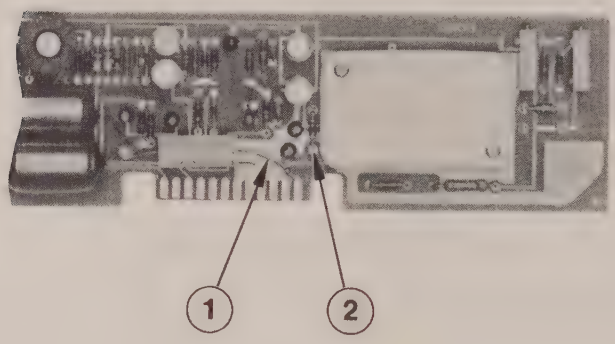


Figure 3.1 - Test Points - Isolator Voltage Zero

3.3 Isolator Current Zero.

a. Connect microvoltmeter across ANALOG OUTPUT terminals on rear panel (Isolator output).

b. Adjust front panel OFFSET (DC) for 0 ± 100 µvolts reading on microvoltmeter.

c. Remove short from point (1) to ground; place FILTER in.

d. Insert 1 Megohm resistor across input terminals.

e. Adjust R12 for output voltage on microvoltmeter of less than ± 100 µvolts.

3.4 DC Gain Adjustment (Digitizer PCB)

a. Set RANGE to AUTO; FUNCTION to DC; depress RATIO.

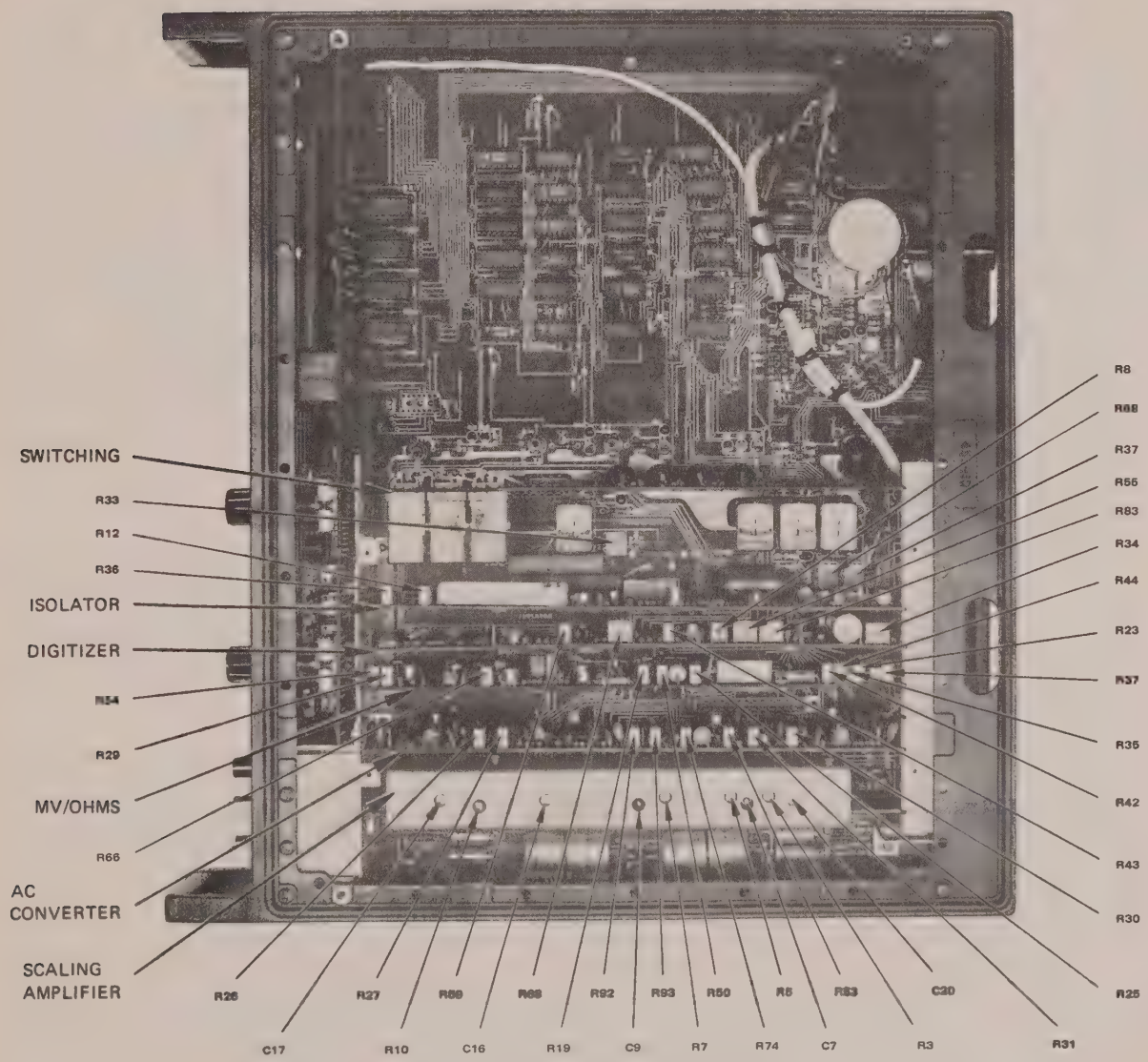


Figure 3.2 - Adjustment Locations

b. Apply inputs to DVM and make indicated adjustments on Digitizer board as listed in the following table.

SIGNAL INPUT	REF. INPUT	MODE	ADJUST: (Figure 3.2)	For Readout of:
-1.90000V	+1.00000	DC/DC	R55	-19.000V
+1.90000V	+1.00000	DC/DC	R68	+19.000V
-19.0000V	+10.0000	DC/DC	verify readout of -19.000V ± 1 digit	
-19.0000V	-	DC*	R43	-19.000V ± 1 digit
+19.0000V	-	DC	R59	+19.000V ± 1 digit

*Switch from RATIO to DC measurement

3.5 Range Calibration. (Main Interconnection PCB)

a. Set FUNCTION to DC; RANGE to AUTO.

b. Apply inputs to DVM and perform the indicated adjustment as listed in following table.

INPUT	ADJUST:	For Readout of:
± .190005	R68 (.1/1KV)	± .19001V
± 1.90005	R37 (1V)	± 1.9001V
± 190.005	R33 (100V)	± 190.01V
± 1000.00	verify readout	± 1000.0V ± .5 digit

3.6 OHMS-MV ACCESSORY.

3.7 Voltage Zero.

a. Short the + and - front input terminals with a copper clip lead.

b. Select DC/MV FUNCTION; 10 MV RANGE; FILTER in.

c. Remove top cover from instrument. Connect microvoltmeter between point (1) (figure 3.3) and ground (- INPUT terminal on front panel).

d. Adjust MV OFFSET on front panel for zero reading on microvoltmeter.

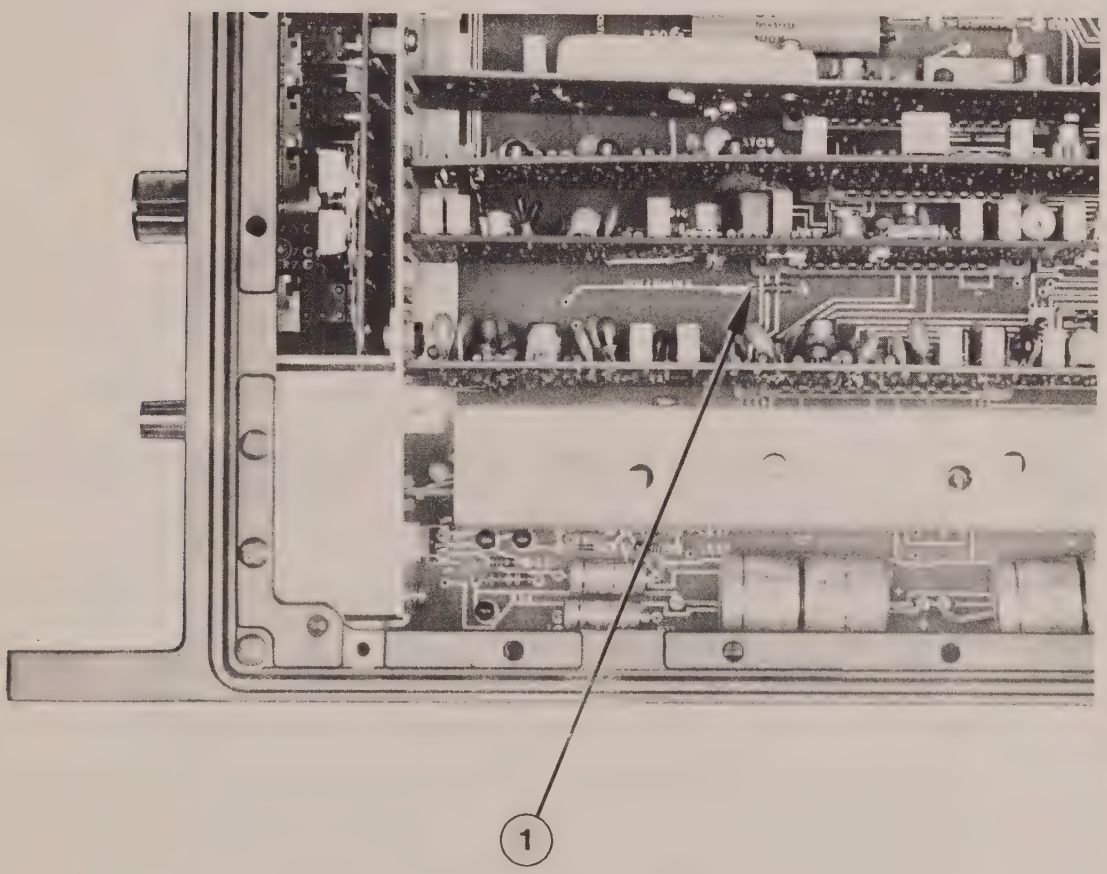


Figure 3.3 - Test Point - MV Offset

3.8 Current Zero.

a. With input still shorted, adjust R66 for 00000 readout ± 1 digit.

b. Remove short across input. Replace clip lead with a 100 Kilohm resistor across input terminals.

c. Adjust R54 for 00000 readout ± 2 digits.

d. Remove 100 Kilohm resistor.

3.9 Gain Adjustment.

a. Set RANGE to 100 MV. Apply +190 MV across input terminals. Adjust R29 for readout of 190.00 MV ± 1 digit.

b. Reverse polarity of input to -190 mV. Check for readout of -190.00 MV ± 1 digit. Readjust R29 as necessary.

3.10 Ohms Calibration.

a. Select MEGOHM function; 100 RANGE. Short the + INPUT, - INPUT, + OHMS CURRENT, and - OHMS CURRENT terminals together.

b. Connect microvoltmeter from + INPUT terminal (+ lead) to - ANALOG OUTPUT terminal on rear panel.

c. Adjust R19 for reading of zero ± 50 μvolts on microvoltmeter. Remove shorts from input terminals.

d. Short the + INPUT and + OHMS CURRENT terminals together; short the - INPUT and - OHMS CURRENT terminals together (two-wire measurement configuration).

e. Select 100 Megohm range; connect input leads to a 100 Megohm standard resistor. Adjust R50 for readout of 100.00 Megohms ± 1 digit.

f. Select 10 Megohm range. Connect input leads to a 19 Megohm standard resistor. Adjust R44 for a readout of 19.000 Megohms ± 1 digit.

g. Select 1 Megohm range. Connect input leads to a 1.9 megohm standard resistor. Adjust R42 for a readout of 1.9000 Megohms ± 1 digit.

h. Select 100 Kilohm range. Connect input leads to a 190 Kilohm standard resistor. Adjust R35 for a readout of 190.00 Kilohms ± 1 digit.

i. Select 10 Kilohm range. Connect input leads to a 19 Kilohm standard resistor. Adjust R23 for a readout of 19.000 Kilohms ± 1 digit.

j. Select 1 Kilohm range. Connect input leads to a 1.9 Kilohm standard resistor. Adjust R37 for a readout of 1.9000 Kilohms ± 1 digit.

k. Select 100 Ohm range. Connect input leads to a 190 Ohm standard resistor. Verify that readout is 190.00 Ohms ± 1 digit.

l. Select 10 Ohm range. Connect input leads to a 19 Ohm standard resistor. Remove + OHMS CURRENT lead from resistor. Verify that readout is 00000.

m. Change FUNCTION to DC/MV, RANGE to 10 MV. Verify readout of 00000. If necessary, readjust MV OFFSET on front panel for zero. Replace + OHMS CURRENT lead to resistor. Return FUNCTION to OHMS, RANGE to 10.

n. Adjust R25 for a readout of 19.000 Ohms ± 1 digit.

> NOTE
>
> When calibrating the 10-ohm and 1-ohm ranges; it is important that standard resistors have low-thermal characteristics. Otherwise, faulty calibration will result.

o. Select 1 Ohm range. Connect input leads to a 1.9 Ohm standard resistor. Verify that readout is 1.9000 Ohms ± 1 digit. If not, repeat the MV Offset adjustment (step m).

3.11 AC CALIBRATION (Perform steps in order listed. Refer to figure 3.2 for adjustment locations.)

3.12 AC Zero Adjustments. Place AC Converter on extender board. Remove Scaling Amplifier and replace with bypass board. Select AC, 1V range. The following zero adjustments are made with input terminals open.

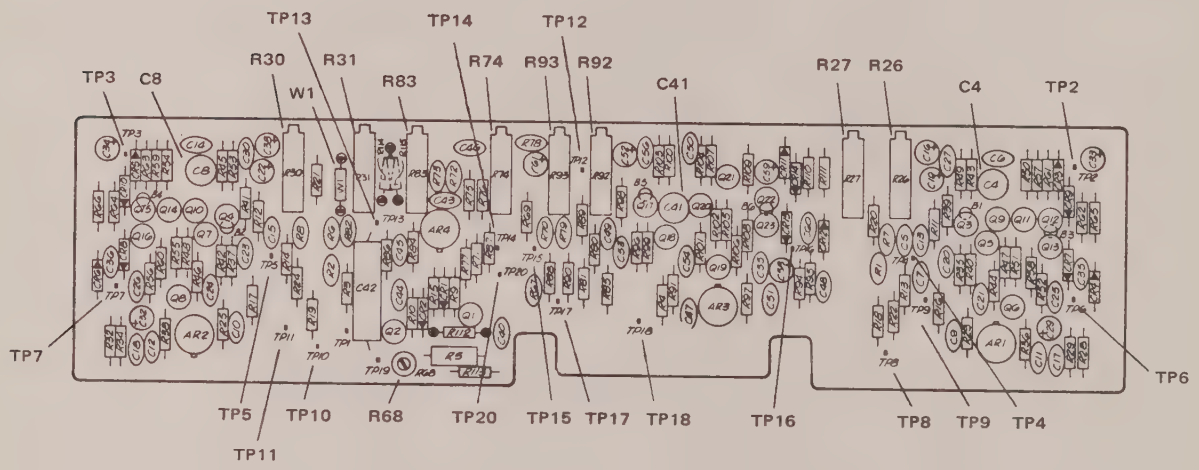


Figure 3.4 - Test Points - AC Converter

a. Bias Current Zero. Connect the microvoltmeter between the test points listed below and ground (TP9, TP11, or TP18). Place a 10 KΩ, 1/4 watt resistor in series with input probe. With the adjustment indicated for each test point, adjust for zero ± 10 μvolts.

Test Point (Figure 3.4)	Adjustment
TP8	R26
TP10	R30
TP17	R92
TP14	R74

b. Voltage Offset Zero. Adjust for zero ± 10 μvolts at the following test points with the indicated adjustment.

Test Point	Adjustment
TP4	R27
TP5	R31
TP15	R93
TP13	R83

c. Output Symmetry Adjustment. Adjust for symmetry at the following pairs of test points (e.g., if TP6 reads +6 μvolts, TP2 will read -6 μvolts when adjusted).

Test Points	Adjust:	Voltage at Balance
TP2, TP6	R27	less than ± 10 μvolts
TP3, TP7	R31	less than ± 30 μvolts
TP12, TP16	R93	less than ± 30 μvolts

3.13 AVT Frequency Response Adjustment. Open jumper W1 on AC Converter (figure 3.4).

a. Apply 1.9000 volts RMS at 1 KHz to DVM input. Record the readout (about 1.5900).

b. Apply 1.9000 volts RMS @ 100 KHz to DVM input. Adjust C4 for same reading recorded at (a).

3.14 Break Amplifier Frequency Response Adjustment.

a. Apply 1.9000 volts RMS @ 1 KHz to DVM input. Record readout.

b. Apply 1.9000 volts RMS @ 100 KHz. Adjust C8 and C41 for minimum or maximum readout without oscillation or going into "lockup".

c. Readjust C8 and C41 for readout obtained in step (a) with approximately equal contribution from each capacitor.

3.15 100 mV Zero Adjustment. Replace jumper W1. Select 100 mV range. Apply 10.000 mvolts, 1 KHz to input terminals. Adjust AC ZERO (front panel) for readout of .01000.

3.16 100 mV Gain Adjustment.

a. Select 1V range. Apply 1.0 volt at 1 KHz and record readout.

b. Select 100 mV range. Apply 100 mV at 1 KHz and record readout.

c. Repeat steps (a) and (b) and adjust R68 for same readout (neglecting decimal point) on both ranges (e.g., .9997 and 99.97).

d. Recheck 100 mV zero adjustment (para. 3.15). Repeat step 3.16, if necessary.

3.17 Scaling Amplifier Low Frequency Gain Adjustment.

a. Remove AC Converter from extender and plug it directly into connector on mother board. Remove bypass board and install Scaling Amplifier in its place.

b. Recheck 100 mV zero (para. 3.15) and readjust AC ZERO (front panel), if necessary.

c. Apply the inputs listed below and adjust the indicated control (on Scaling Amplifier) for a readout equal to the input voltage.

RANGE	INPUT		
	VOLTAGE	FREQ	ADJUST
1V	1.9000V	1 KHz	R10 (1V LF)
10V	19.000V	1 KHz	R7 (10V LF)
100V	100.00V	1 KHz	R5 (100V LF)
1 KV	1 KV	1 KHz	R3 (1 KV LF)

3.18 Scaling Amplifier High Frequency Gain Adjustment. Apply the inputs listed in the following table and adjust the indicated control (on Scaling Amplifier) for a readout equal to the applied input. Steps must be performed in the order listed. After all five steps are completed, recheck each adjustment for the effects of interaction. Readjust, if necessary. Check frequency response to 1 MHz.* Readjust high frequency (HF) adjustments if necessary. Check .1V range for calibration and frequency response.

*Maximum Inputs:
1000V to 20 KHz
500V to 40 KHz
100V to 200 KHz
20V to 1 MHz

3.19 After replacing AC Converter into closed DVM, recheck the 100 mV zero after instrument has warmed up for several minutes. Readjust R10, if necessary.

3.20 NORMAL AND COMMON MODE CHECK (Optional).

3.21 Additional Equipment Required:

a. A 100 ohm, 1/4 Watt Carbon Resistor

b. Two 1-1/2 Volt Batteries

c. A 10K Ohm 1/4 Watt Carbon Resistor

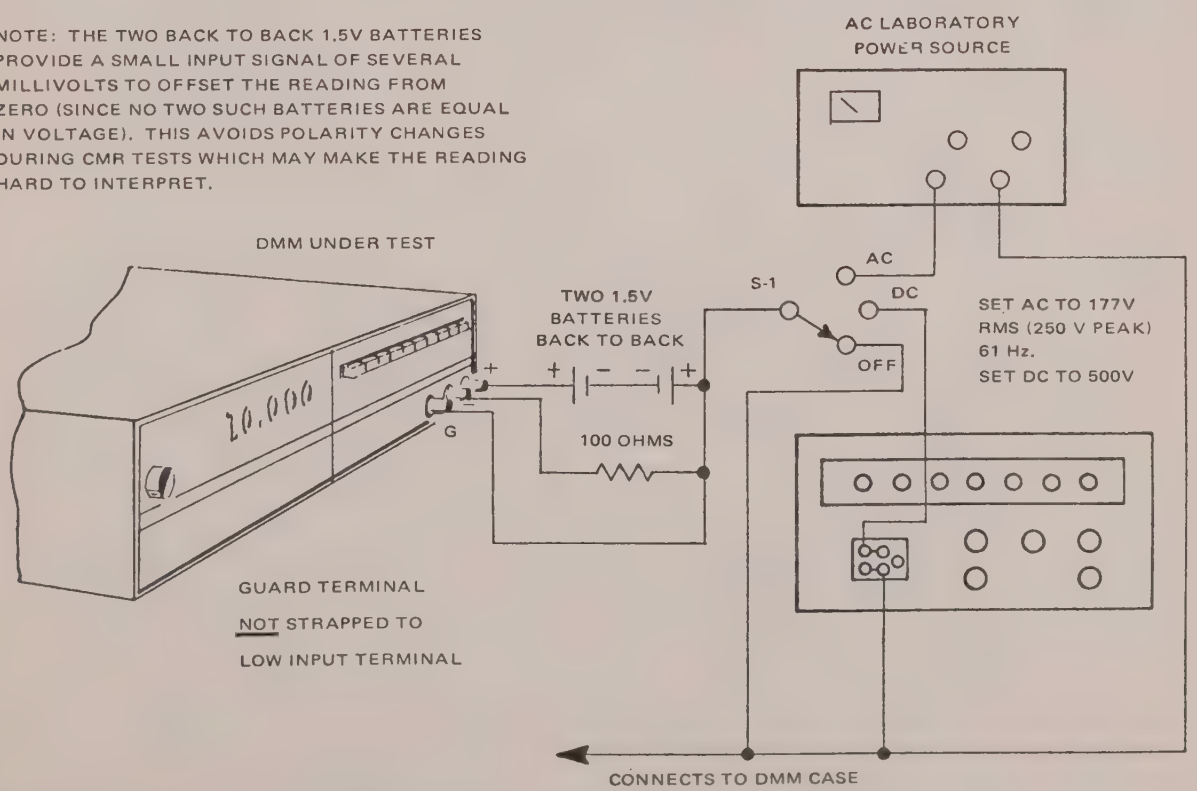
d. A 1 ufd (non polar) Capacitor

3.22 Connect the equipment as shown in the following figures and perform the checks as described in the tables.

COMMON MODE REJECTION (In DC Volts Function)

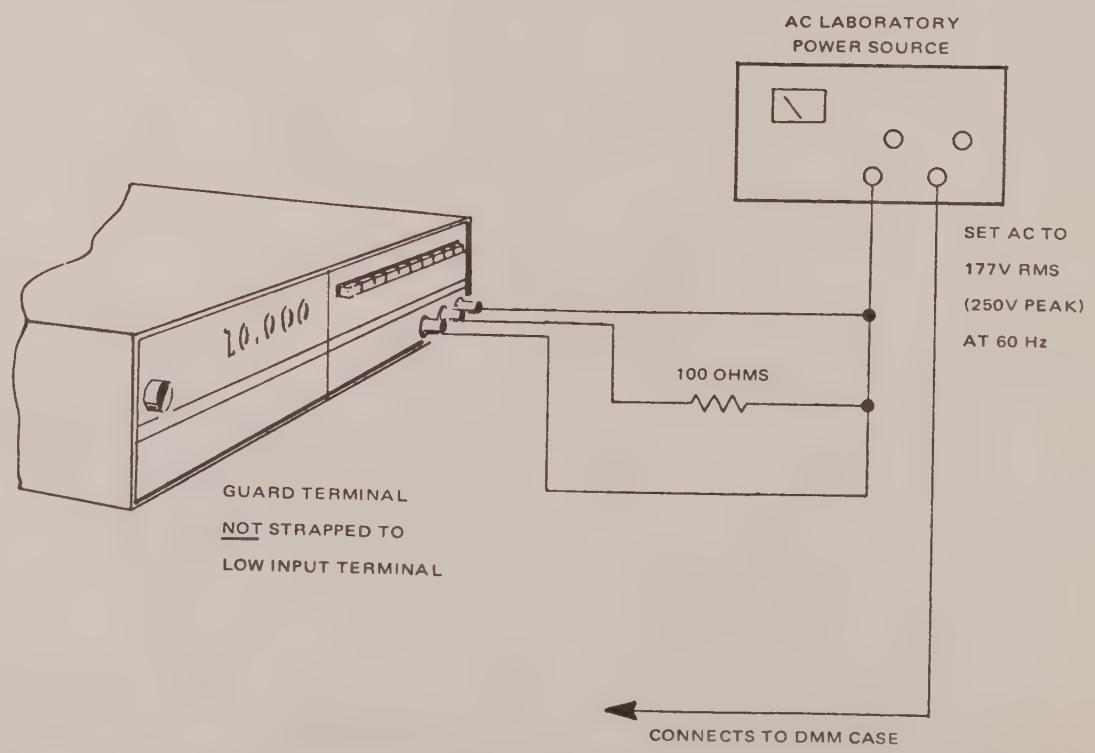
DMM		INPUT SIGNAL		NOMINAL READING See Note 1	TOLERANCE	NOTE
FUNCTION	RANGE	S-1				
DCV FILT. OUT	0.1	Off			±1 digit from nominal	1) With switch S-1 in the off position, record the reading displayed on the DMM's readout in the "nominal reading" boxes of the table. ±5 digits = 140 dB – DC ±25 digits = 120 dB – AC ±12 digits = 126 dB – AC
		DC			±5 digits from nominal	
		AC			± 25 digits from nominal	
DC V FILT. IN	0.1	DC			±5 digits from nominal	
		AC			±12 digits from nominal	

NOTE: THE TWO BACK TO BACK 1.5V BATTERIES PROVIDE A SMALL INPUT SIGNAL OF SEVERAL MILLIVOLTS TO OFFSET THE READING FROM ZERO (SINCE NO TWO SUCH BATTERIES ARE EQUAL IN VOLTAGE). THIS AVOIDS POLARITY CHANGES DURING CMR TESTS WHICH MAY MAKE THE READING HARD TO INTERPRET.



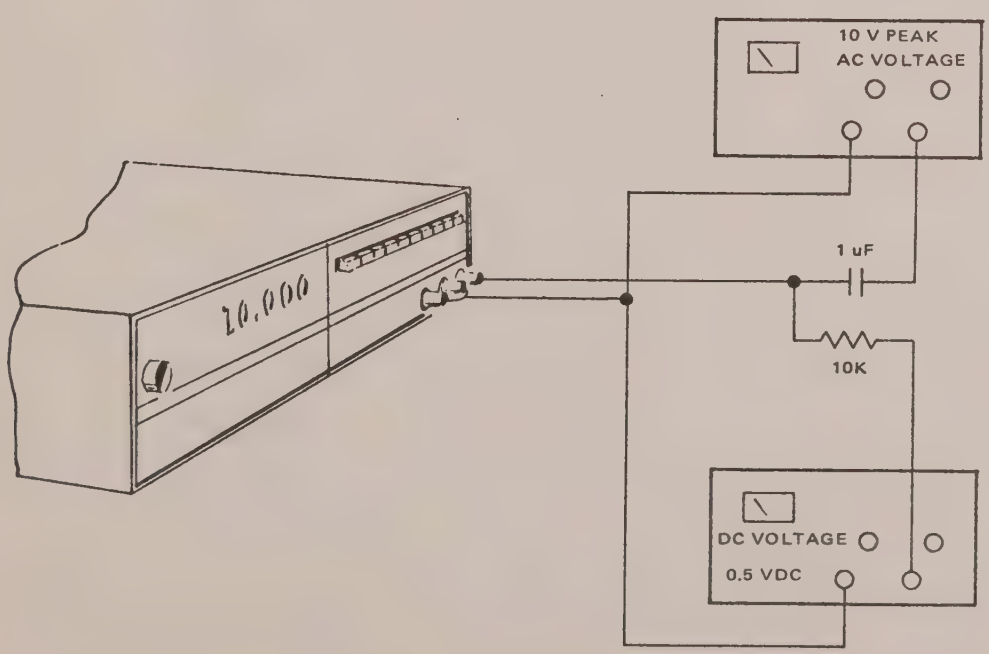
COMMON MODE REJECTION (In AC Volts Function)

DMM		COMMON MODE INPUT SIGNAL		NOMINAL READING	TOLERANCE	NOTE
FUNCTION	RANGE	VOLTAGE	FREQ.			
AC	1	177V RMS	60 Hz	.17800	± 2 digits	Enter reading with shorted input in nominal column before beginning
	10	177V RMS	60 Hz	.1780	±18 digits	
	100	177V RMS	60 Hz	.178	±18 digits	
	1000	177V RMS	60 Hz		±18 digits	
	0.1	177V RMS	60 Hz		±18 digits	



NORMAL MODE NOISE REJECTION (In DC Volts Function)

DMM		INPUT SIGNAL		NOMINAL READING	TOLERANCE	NOTE
FUNCTION	RANGE	DC	AC			
DC	10	0.5V		00.500	± 1 digit	
FILT. OUT		0.5V	10VP60 Hz	00.500	±40 digits	
FILT. IN	10	0.5V	10VP59 Hz	00.500	±40 digits	
	1	0.5V	10VP300 Hz	0.5000	± 3 digits	



SECTION 4

THEORY OF OPERATION

4.1 GENERAL.

4.2 This section covers the general theory of the Model 4800 DVM. The instrument is defined in terms of its operating principles and the sequence of a normal measurement. Each board is then described individually. All drawings in this section are simplified for the purpose of this description and serve only to supplement the complete drawings of Section 5.

4.3 The Model 4800 DVM is a programmed, dual-slope integration instrument, consisting of three major functional parts; signal conditioning, integrating, and display. The signal conditioning portion consists of the switching card, AC converter, ohms converter, millivolt converter (Preamplifier), attenuator, isolator, and filter. The function of these components is to convert the incoming signal to a stable DC signal, scaled to 10 volts full-scale. The integrating portion consists of the integrator, amplifier, null detector, and the plus and minus reference supplies. The purpose of these components is to convert the conditioned input signal into an equivalent time-period and transmit this time period to the display portion of the DVM. The signal conditioning and integrating portions are floating and isolated from the grounded display portion to achieve high common mode rejection. All digital inputs and outputs are interfaced through the display portion.

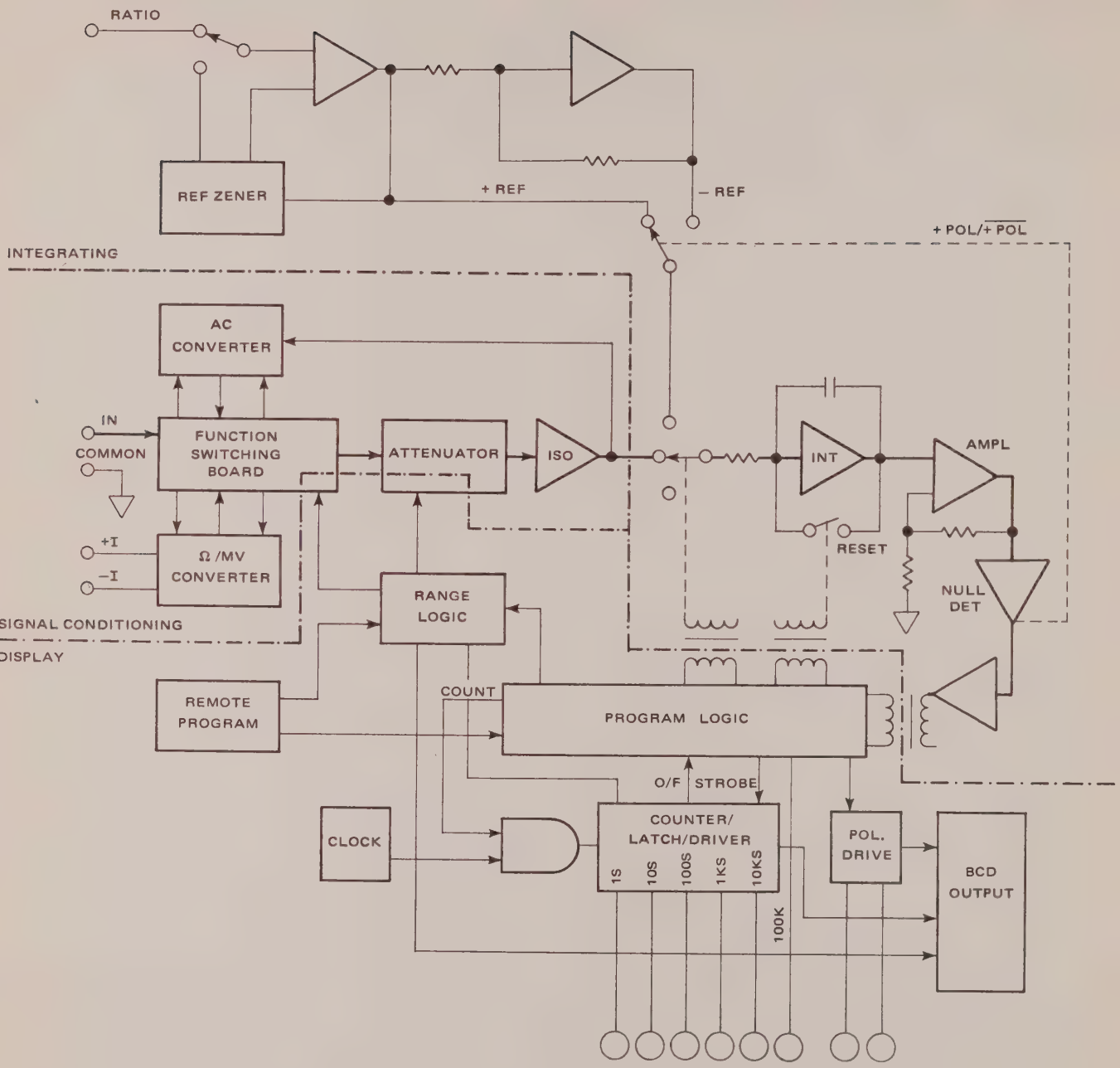


Figure 4.1 - Block Diagram 4800 DVM

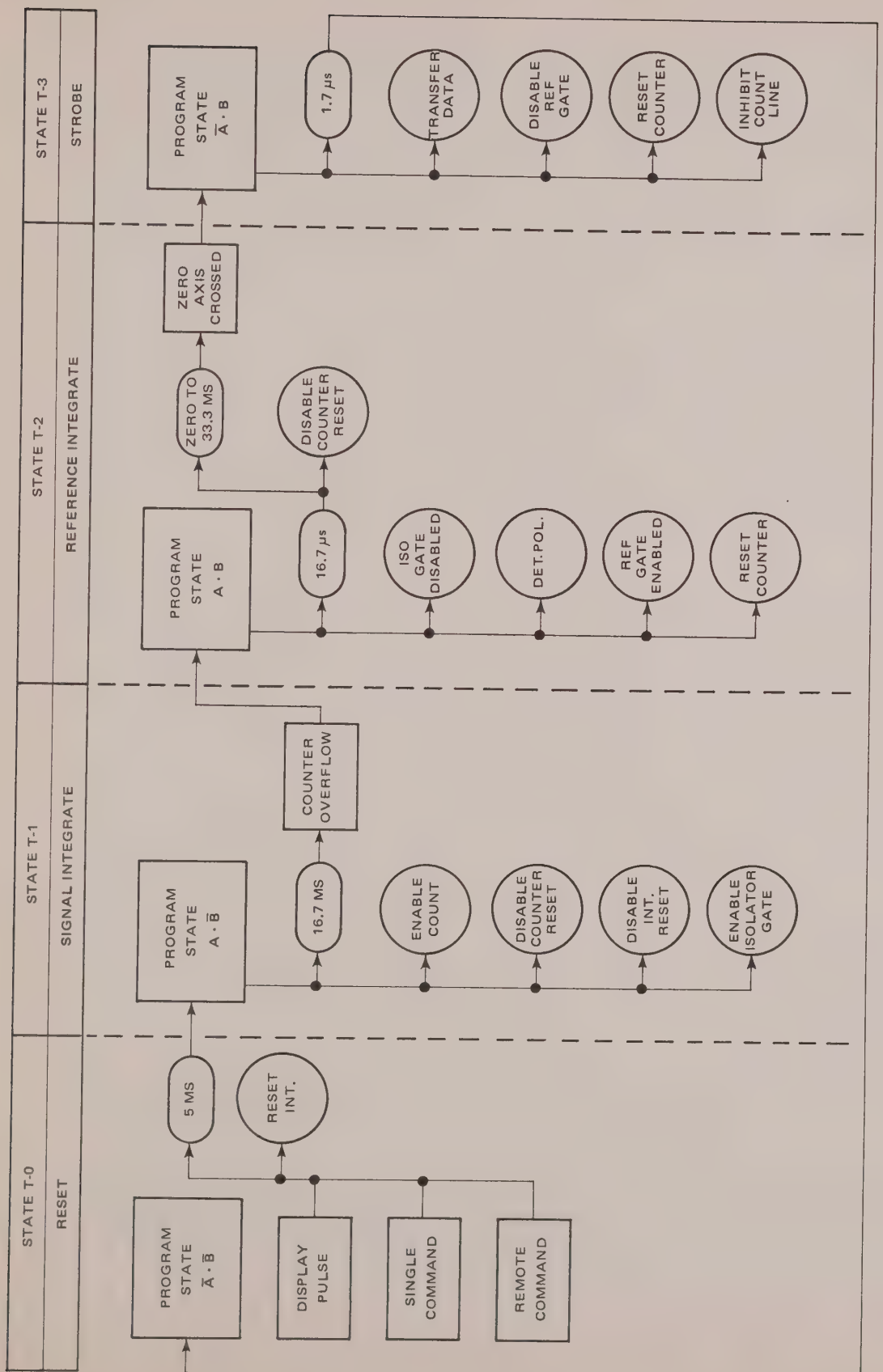


Figure 4.2 - Sequence Timing Diagram

4.4 The display portion consists of the program logic, range logic, clock, counter, storage, readout, remote program, and BCD output. The purpose of the display portion is to control the signal conditioning and integrating portions and to convert the time-period generated by integrator into a numeric value for display by the readout.

4.5 The Model 4800 is shown in a simplified block diagram form in figure 4.1 and a program sequence timing diagram in figure 4.2. Referring to these figures, the instrument follows four well defined program states, generated by two flip-flops (designated A and B) in the program logic.

4.6 PGM-0. This state is the reset step, with the value of the previous DVM reading displayed on the NIXIE readout and the instrument prepared to accept a command for a new reading. This step is defined by the program logic flip-flops being in the state $\overline{A} \cdot \overline{B}$. Read commands are generated in three ways; internally every 250 milliseconds + reading time with PERIODIC selected, externally, by depressing the SINGLE button on the front panel with HOLD selected, or remotely by externally generating a command pulse with REMOTE selected. The command pulse, regardless of how produced, initiates a 5 millisecond delay during which the integrator is reset to zero.

4.7 PGM-1. At the completion of the 5 ms delay, the program logic advances to $A \cdot \overline{B}$ and the signal integrate sequence begins. The signal integrate period converts the conditioned input signal into an equivalent charge, that is a function of

the input value and the integration period. At the beginning of the signal integration period, the count line is enabled, permitting clock pulses to advance the counter at the clock rate (600 KHz). Simultaneously, the integrator reset is disabled and the isolator gate is enabled, permitting the integrator to charge at a rate determined by, and a polarity opposite to, the input signal. After 16-2/3 milliseconds, the counter overflows (10,000 clock cycles) and the signal integration period is complete.

4.8 PGM-2. The counter overflow advances the program logic to A · B and a 16.7 microsecond delay pulse is generated. The isolator gate is disabled, the polarity of the input signal is determined, and the reference gate is enabled (the gate is selected which connects the integrator input to the reference having the opposite polarity as the input signal). During the delay pulse, the counter is held at zero by the counter reset (for ten clock counts) to permit settling of the integrator. At the end of the delay, the reset is disabled and the counter again advances at the clock rate. The integrator begins discharging at a rate determined by the reference voltage. The time required for the integrator to discharge is measured by the clock-counter and is determined by the initial charge developed during the signal integration period. The state T-2 is completed when the integrator charge returns to zero and is indicated by the zero axis crossing signal. The time required for the period to elapse is the sum of the 16.7 microsecond delay and the time interval of the reference integration (zero to 33.3 milliseconds with 100% overrange).

4.9 PGM-3. When the zero axis signal is produced, the program logic is advanced to $\overline{A} \cdot \overline{B}$, the Strobe step. A strobe pulse (one clock pulse) is generated, com-

manding the storage to transfer the data from the counter to the storage memory. The storage retains the data which is displayed by the readout until the next program T-3 (strobe from next reading). At the same time, the reference gate is disabled, the counter is reset to zero, and the count line is inhibited. The completion of the strobe pulse advances the program logic to $\overline{A} \cdot \overline{B}$ (T-0) and the instrument is ready to take a new reading.

4.10 BOARD DESCRIPTION.

4.11 When fully loaded, the Model 4800 consists of nine printed circuit boards, eight of which plug into the remaining "mother" board.

4.12 INTERCONNECTION & LOGIC BOARD (403433). This is the largest board in the instrument and provides the most functions. It couples all of the other boards together and on it is located the circuits for the power supplies, readout, BCD output, program counter, range logic, attenuator, and isolator gain. This board along with the display board comprise the entire digital section. Basically there are two power supplies (shown clearly on schematic 430958, sheet 5 of 5), completely separate and isolated from each other. The digital supply consists of a high current handling plus five volt supply for powering the digital circuitry, a plus 220 volt supply for the nixie readout tubes and the display board, and a minus one volt supply for use on the remote program board. The analog supply consists of a plus and minus 31 volt unregulated supply and a regulated plus and minus 18 volt supply, both referenced to analog ground. These supplies provide power for all of the analog circuits of the DVM.

4.13 The Readout consists of the readout tubes, decoder-drivers, storage, decade counters, overflow counters, and down range logic. The counter receives clock pulses during the entire integration period (program states 1 and 2) but the counter advancement is temporarily halted when the highest decade overflows. The overflow signal is produced by the 8 bit of the highest decade (going false) causing the overflow counters to advance and generating a 16.7 microsecond counter reset pulse from the display board. The reset pulse prevents the counter from advancing for the duration of the pulse period. The overflow also causes the program counter to advance to program state 2 (reference integration period). The storage retains the counter setting from the previous reading until commanded to accept new data by a strobe pulse (program state 3). The down range logic indicates when the display is less than (false) or equal or greater than (true) 1000.

4.14 The BCD output for the numeric data is taken from the output of the readout storage. The majority of the remaining output data originates on the display board.

4.15 The program logic dictates the timing and operating sequence of the DVM and consists primarily of a four step counter. The counter is advanced initially by the read command, which may be generated internally, at the front panel, or externally through the PGM command of the remote option or the DVM command of the standard printer connection. The counter is advanced through the remaining program steps by the counter overflow and axis crossing detector. (See figure 4.2, Sequence Timing Diagram.)

4.16 The range logic consists of a synchronous 4-bit up/down counter, two full adders, and sundry gates. The circuitry, with AUTO RANGE selected, automatically selects the most suitable range for the input signal being monitored. Associated circuitry detects when the instrument is in a range unsuitable for the function selected and automatically selects the 1000 range, even with HOLD selected.

4.17 The two full adders operate as equality detectors, one for maximum range and the other for minimum range of any given function. The adders compare the output of the up/down counter with a binary code, the value of which is dependent on the function selected (see table 4.1). When the numeric sum of the two binary inputs to the maximum autorange limit detector is greater than 15, the up/down counter is inhibited from counting up. When the numeric sum of the MIN autorange limit detector is not greater than 15, the up/down counter is inhibited from counting down.

Table 4.1 - Range Limit Codes

Function	Max Limit				Range	Min Limit				Range
	1	2	4	8		1	2	4	8	
Ω	0	1	1	0	9	0	1	1	1	1
DC/MV	0	0	0	1	7	1	0	1	1	2
DC	0	0	0	1	7	0	0	1	1	3
AC	0	0	0	1	7	0	0	1	1	3

4.18 The count commands to the up/down counter are in the form of two normally true clock lines. The positive going edge of a negative pulse applied to the appropriate clock line causes the counter to count up or down by one count. Each of the four flip-flops in the up/down counter can be individually preset. By pulling the LOAD line on the counter to ground, the outputs of the counter assume the level of

the preset lines. In manual range the load line is always false and the binary data from the range switch is transferred directly through the counter. In autorange, the load line is normally true and control is through the clock lines.

4.19 Range changes are generated if required during program step 3 (the one-clock-pulse-long strobe during which the data from the decade counters is transferred to the storage). At this time a pulse, designated $\overline{X}$ and generated solely for the range circuitry, is enabled ($\overline{X}$ is generated with clock but lags it by 90°). The enabled $\overline{X}$ generates an up range command, a down range command or neither if the proper range has been reached. An up range command is generated if $\overline{\text{MAX LIMIT}}$ is true (instrument is not in the highest possible range for the function selected) and $\overline{Q_2 O/F}$ is true (instrument has reached the 100% overrange limit). A downrange command is generated if the MIN LIMIT detector is true (instrument is not in the lowest possible range for the function selected) and down range is true (readout is less than 10% of full-scale).

4.20 In addition to the normal autorange functions, the same basic circuits take the instrument out of forbidden ranges that may develop when a function is changed and the instrument is in PGM-0.

4.21 In program step 0, the one bit that is normally added to the value of the up/down counter through the carry in of the MAX LIMIT full adder is removed, effectively subtracting one. Also, a one bit is added to the MIN LIMIT full adder. This action effectively expands the minimum and maximum limits by one digit in each direction; it permits the instrument range to be at the minimum or maximum setting for a given function without producing a limit signal ($\overline{\text{carry out}}$ for max, carry out for min) for

either full adder. If the instrument is in autorange and the range position is outside the range limits for the selected function, a limit signal is generated during program step 0, allowing an $\overline{X}$ pulse to generate a load command to the up/down counter. When in autorange, the range lines are automatically set to the 1000 range, forcing the up/down counter to the 1000 range (this range is legal for any function selected).

4.22 ATTENUATOR & GAIN NETWORKS (430958, sheet 4 of 5). The attenuator is a precision voltage divider used in DC voltage measurement. The attenuator basically consists of double pole, double throw relay and three precision resistors. There are two states available: X1 - no attenuation occurs and the dc volts input from the switching card is fed through a 100 Kohm resistor to the isolator + input; X.01 - the dc volts input is applied through a 100 to 1 divider having an input resistance of 10 megohms and an output resistance of 100 Kohms. The output of the divider is applied to the isolator plus input. The isolator gain network permits the isolator to operate at gain levels of X1, X10, and X100. This divider consists of two voltage tap positions on a single voltage divider string and two relays. Relay settings determine the amount of negative feedback applied to the isolator input, thereby setting the gain.

4.23 DISPLAY BOARD (403430). On this board are mounted: the annunciators and drivers for the functions, Ratio, plus and minus polarity and NO, decimal point drive, the isolator gain relay decode and drive, Ratio relay drive, filter relay drive, overflow (counter, storage, and drive) Range switch, function switch, and counter reset logic. The decimal point drive consists of a gas tube type BCD to ten line converter. The isolator gain relay decode is derived from a low voltage type BCD to 10 line decoder. Ratio and filter drive circuits are initiated from front panel switches. The

overflow counter consist of two JK flip-flops preset to 0-0. The flip-flops are advanced during a measurement cycle by the overflow of the decade counters. The output of the f/f's steer two D type f/f's (storage) and a one shot generator (counter reset), on the first counter overflow, the counters advance to 1-1, and the counter reset is energized. If a strobe is generated, the storage is commanded to transfer and the 0 of the overflow nixie is energized, if one more overflow is generated prior to the strobe, the counter advances to 0-1 and the 1 of the overflow nixie is energized, and if two overflows are generated prior to the strobe, the counter advances to 1-0 and the overflow nixie indicates 2. The range selector provides nine range positions and auto. These positions are encoded into a standard 1, 2, 4, 8 BCD code by a diode matrix. The function switch has four positions and are used directly as negative true logic inputs.

4.24 SWITCHING BYPASS CARD (410615). This board is used in basic instruments only (AC, Millivolts or Ohms/Millivolts options not included). The PC board has two interconnecting printed circuit straps that tie pin E to pin L and pin P to pin 15 of connector J6.

4.25 SWITCHING CARD (403431). This board is used whenever the AC, Millivolt or Ohms/Millivolt options are included in the DVM. The board consists of three relays, their drivers, and an accessory range matrix. As shown in figure 4.3, relay K2 is energized when the AC function is selected, K3 is energized when the ohms function is selected and K1 is energized as indicated by the Boolean equations given. The seven range lines that comprise the output of the accessory range matrix are negative true (minus 31 volt equal true and zero volts equal logic false). The logic for each of the accessory range lines is given in the figure. The purpose of the relays is to

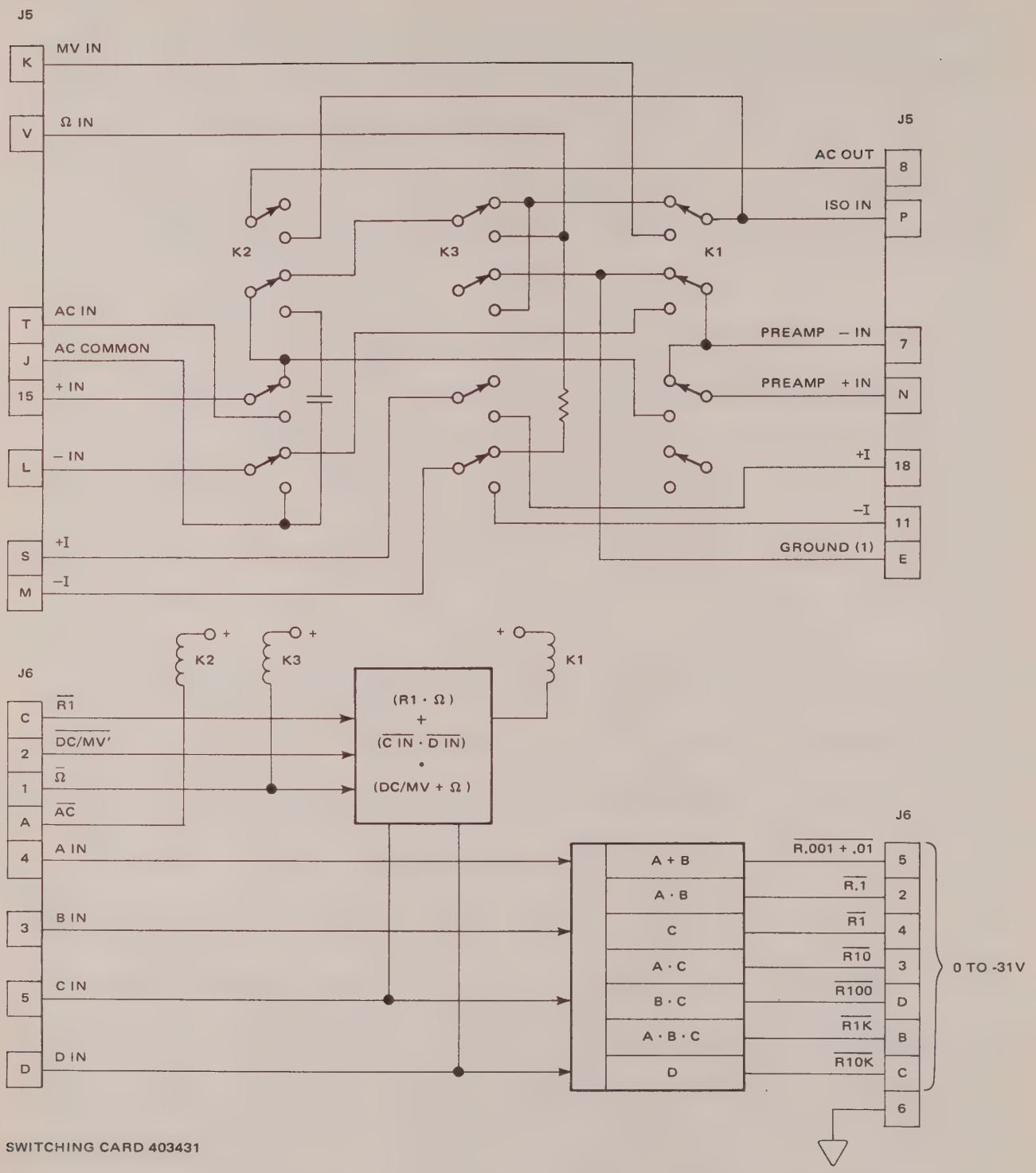


Figure 4.3 - Simplified Schematic — Switching Card

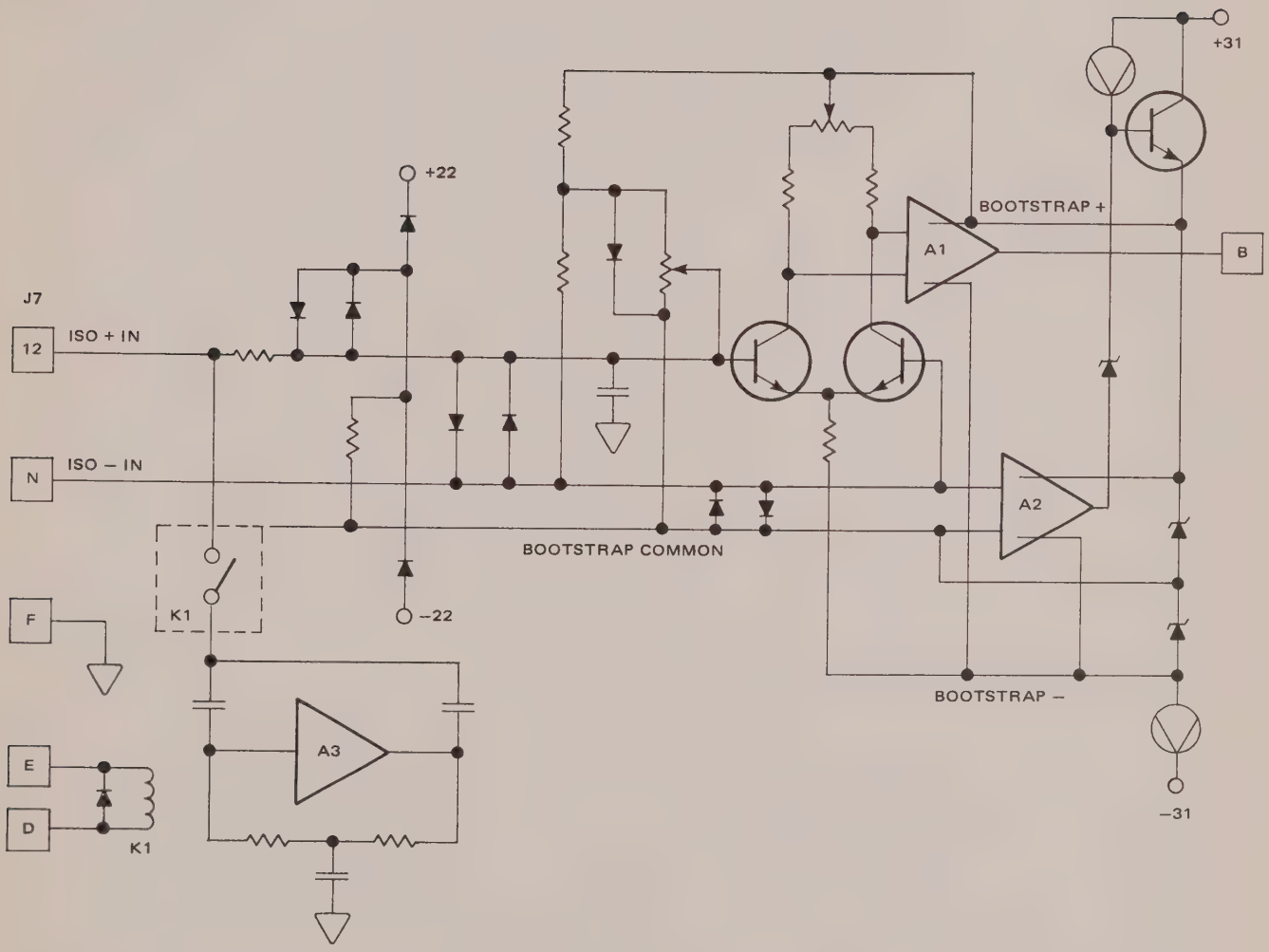
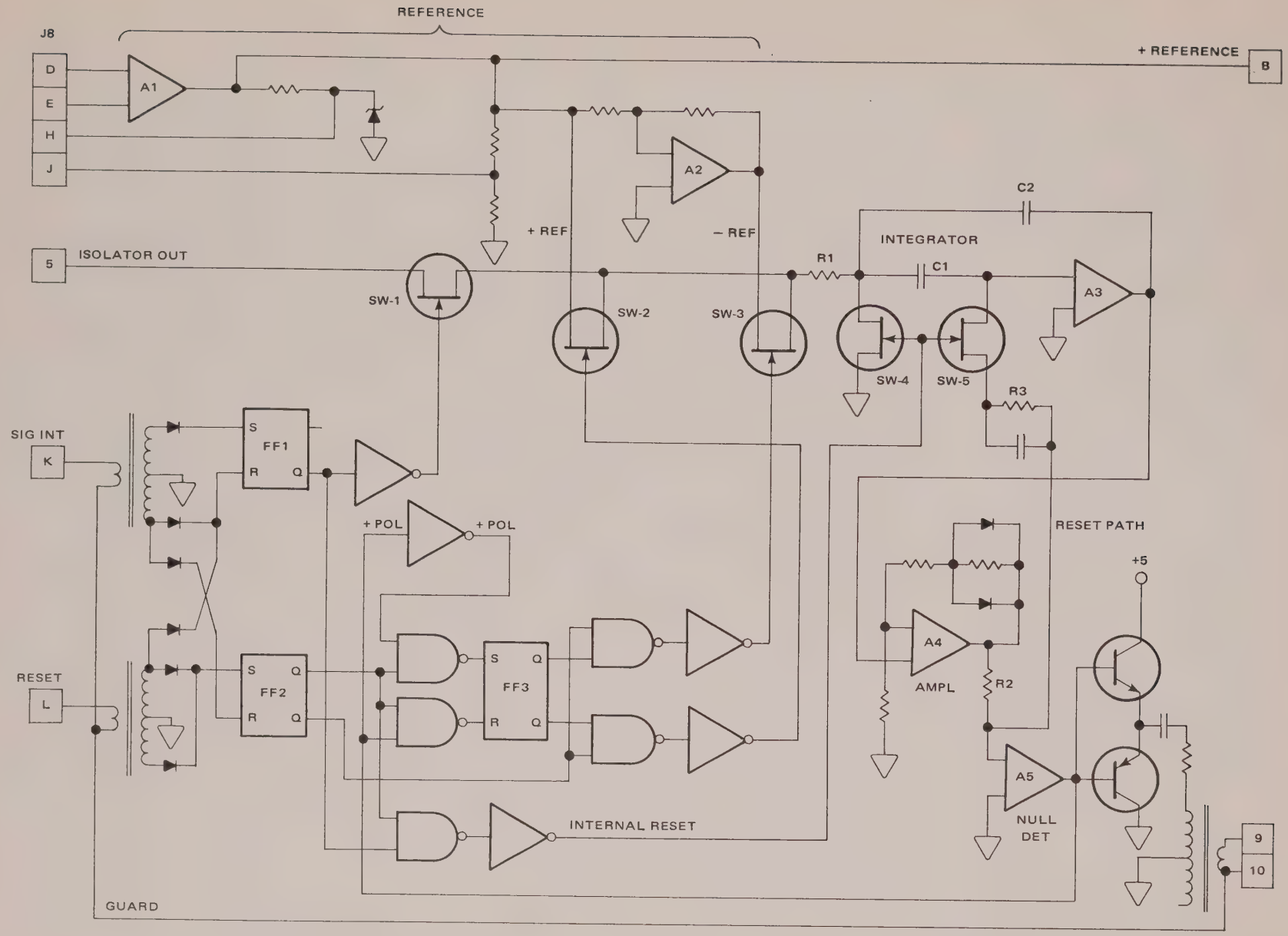


Figure 4.4 - Simplified Schematic — Isolator

route the input signal to the attenuator when the DC function is selected on the appropriate accessory module when AC, Ohms or Millivolts is selected.

4.26 ISOLATOR ASSEMBLY (403434). The isolator receives the conditioned input signal from the attenuator on the mother board. With filter selected or when the AC function is selected (in which case filter is automatically selected) normal mode noise on the input signal is attenuated. Filtering is achieved by an active 3-pole filter, working in conjunction with the 100 Kohm impedance of the attenuator. The input signal is then buffered and if required amplified by the isolator. The isolator (shown simplified in figure 4.4) consists of an input-current-compensated differential stage (with emitter follower omitted for simplicity) driving a 748 op amp. These stages receive their plus and minus power from a bootstrap supply. The bootstrap arrangement allows the isolator stages to follow the input signal, thereby greatly enhancing the effective input impedance. The output of the microamp drives a discrete output stage powered by the plus and minus 31 volt supplies and permitting an output swing of greater than plus or minus twenty volts.

4.27 DIGITIZER ASSEMBLY (403432). The digitizer accepts the conditioned input signal from the isolator and converts it to a set of timing signals for transmission to the logic circuitry. The digitizer, shown simplified in figure 4.5, consists of three switches, integrator, amplifier, null detector, output transformer, two demodulators, and decode logic. The operating sequence is determined by the program logic (see figure 4.2). The output of the isolator is applied to a FET (switch 1) connected to the input of the integrator. Two other FET switches (2 and 3) tie the integrator input to either the plus or minus reference supplies. All these switches are off during the



NOTE: DESIGNATIONS OTHER THAN CONNECTORS OR CONNECTOR PINS USED IN THIS DRAWING AND IN THE TEXT ARE FOR IDENTIFICATION PURPOSES ONLY AND DO NOT NECESSARILY CORRESPOND TO ANY DESIGNATIONS USED ON ACTUAL ASSEMBLY OR SCHEMATIC DRAWINGS. DIGITIZER (403432)

Figure 4.5 - Simplified Schematic — Digitizer

T-0 program step. The voltage level of the plus and minus reference supplies, (P1, P2) is 10 volts when ratio is not selected (internal reference). With ratio selected the reference supplies are equal to the value of the external reference input. Switching between ratio and internal reference takes place on the mother board. The reference element and feedback resistors for the internal reference are located on the digitizer board.

4.28 When program step T-1 is initiated, a positive pulse appears on the signal integrate line causing f/f1 $\overline{Q}$ to go false, turning on switch 1 and turning off the integrator reset switches (described later). From the previous reading a negative pulse on the reset line causes f/f2 Q to go true causing f/f3 Q to follow the polarity of the integrator. With switch 1 closed, the isolator output voltage (+10V in this discussion) is sensed through R1C1 by the input of the integrator amplifier A3, causing the output of the amplifier to go negative. The output draws current through C2 pulling the R1C1 junction back towards zero. Equilibrium is reached when the current through R1 equals the current through C2 causing the junction of R1, C1, C2 to be at approximately zero volts and the output of the amplifier (voltage across C2) increasing linearly in the negative direction. The integrator charges for 16-2/3 milliseconds (counter overflow). The charge across the integrator is now -5 volts (with +10 volts in). When the counter overflows (program step T-2) a negative pulse appears across the signal integrate transformer causing both f/f's1 and 2 to reset. This turns switch 1 off and turns switches 2 or 3 on depending on the position of f/f3 (polarity of the integrator output) with +10 volts in, switch 3 is selected and applies -10 volts to the integrator

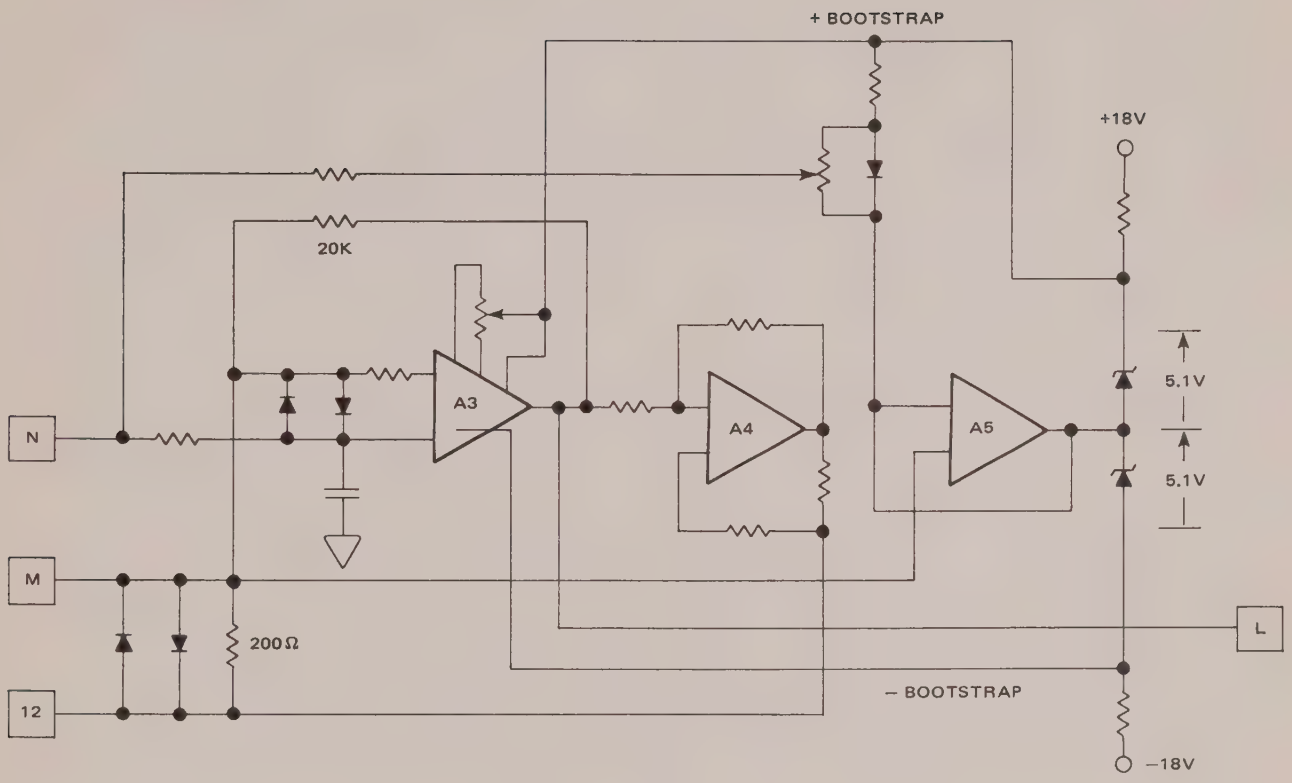


Figure 4.6A - Simplified Schematic — Millivolts Preamp of Millivolts/Ohms Converter Board

input. Because in this example the input is equal but opposite, the time required to discharge the integrator is equal to the time required to charge the integrator or 16-2/3 milliseconds. The output of the integrator is amplified by a gain of approximately 100 and applied to the input of the null detector through resistor R2. The null detector

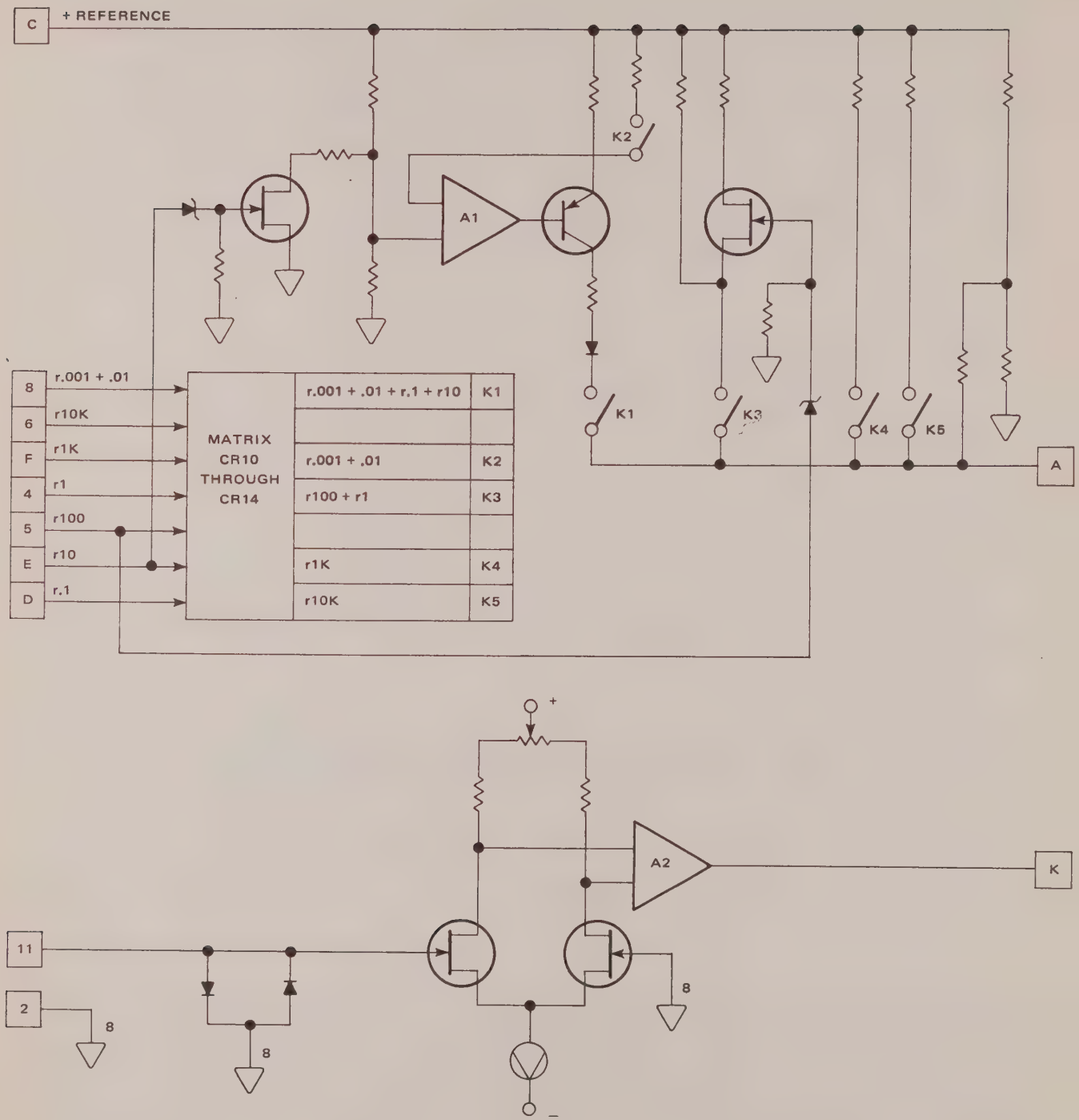


Figure 4.6B - Simplified Schematic – Ohms Converter of Millivolts/Ohms Converter Board

inverts the integrator causing the transformer driver to set at +5 volts during the entire integrate period. When the charge across the integrator reaches zero the transformer driver goes to zero causing the program logic to advance to program step T-3. At this time a negative pulse on the reset line resets f/f2 opening the reference switch and energizing the internal reset line. This line shorts the junction of R1, C1, and C2 to ground and connects the junction of C1 and input A3 to the junction of R2 and input A5. This allows the input voltage errors of A3 and A4 and any input current error of A5 to be lumped together and reduced by a factor equal to the product of both amplifiers A3 and A4 (C1 changes to required offset during reset).

4.29 MILLIVOLT (Preamplifier). This option is available as a separate option (403464) or combined with the Ohms converter (403435) and consists of a precision, fixed gain amplifier. As shown in figure 4.6, the millivolt amplifier consists of three parts: a potentiometric amplifier (A3) set at a fixed gain of 100, a "current sink" amplifier (A4), and a bootstrap amplifier (A5). The potentiometric amplifier is a stable low-drift op amp with voltage and current offset compensation. The power to the potentiometric op amp is supplied by the bootstrap supply, providing extremely high input impedance. The op amp output drives a discrete component amplifier for greater voltage swing. The bootstrap amplifier is non-inverting with a voltage gain of one. The input of the bootstrap is tied to the junction of the potentiometric amplifier allowing the bootstrap supplies to follow the input voltage.

4.30 The current sink eliminates measurement errors due to I.R. drops developed in the common line by the feedback resistance of the potentiometric amplifier. The amplifier A4 monitors and inverts the output of the potentiometric amplifier to provide,

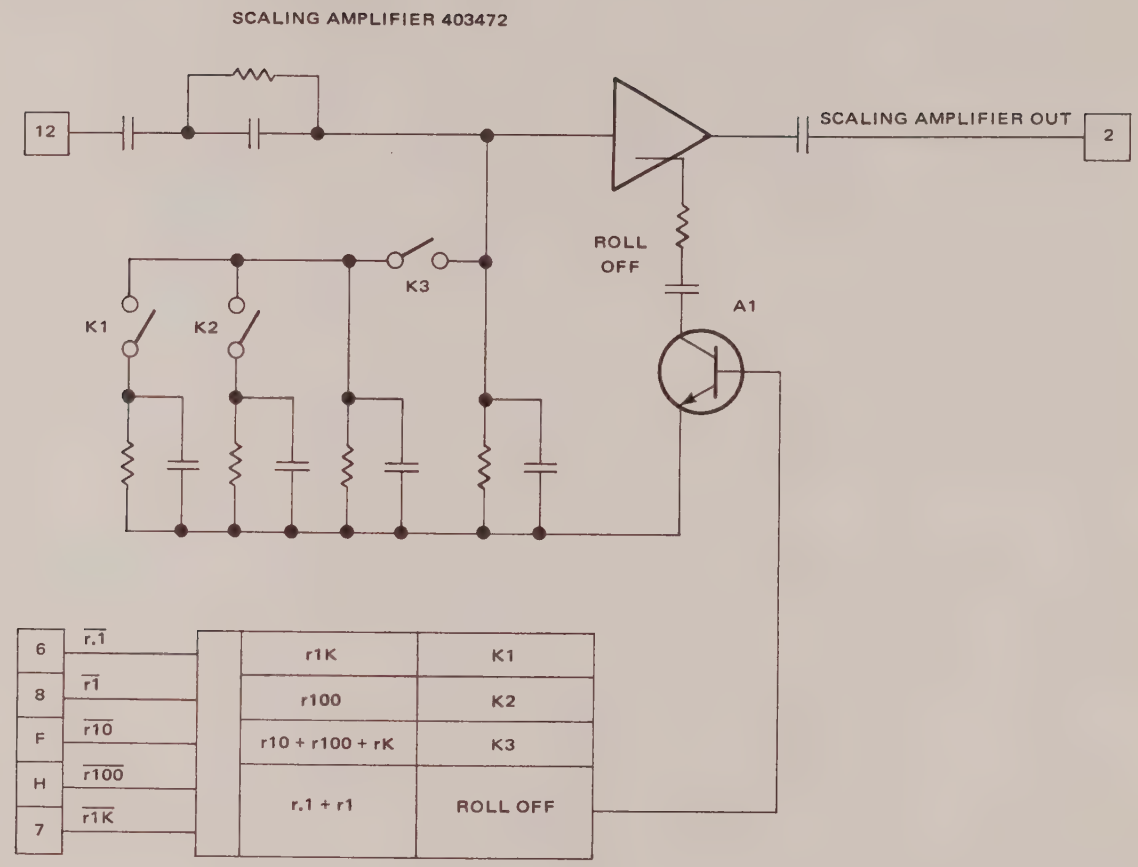


Figure 4.7 - Simplified Schematic — Scaling Amplifier

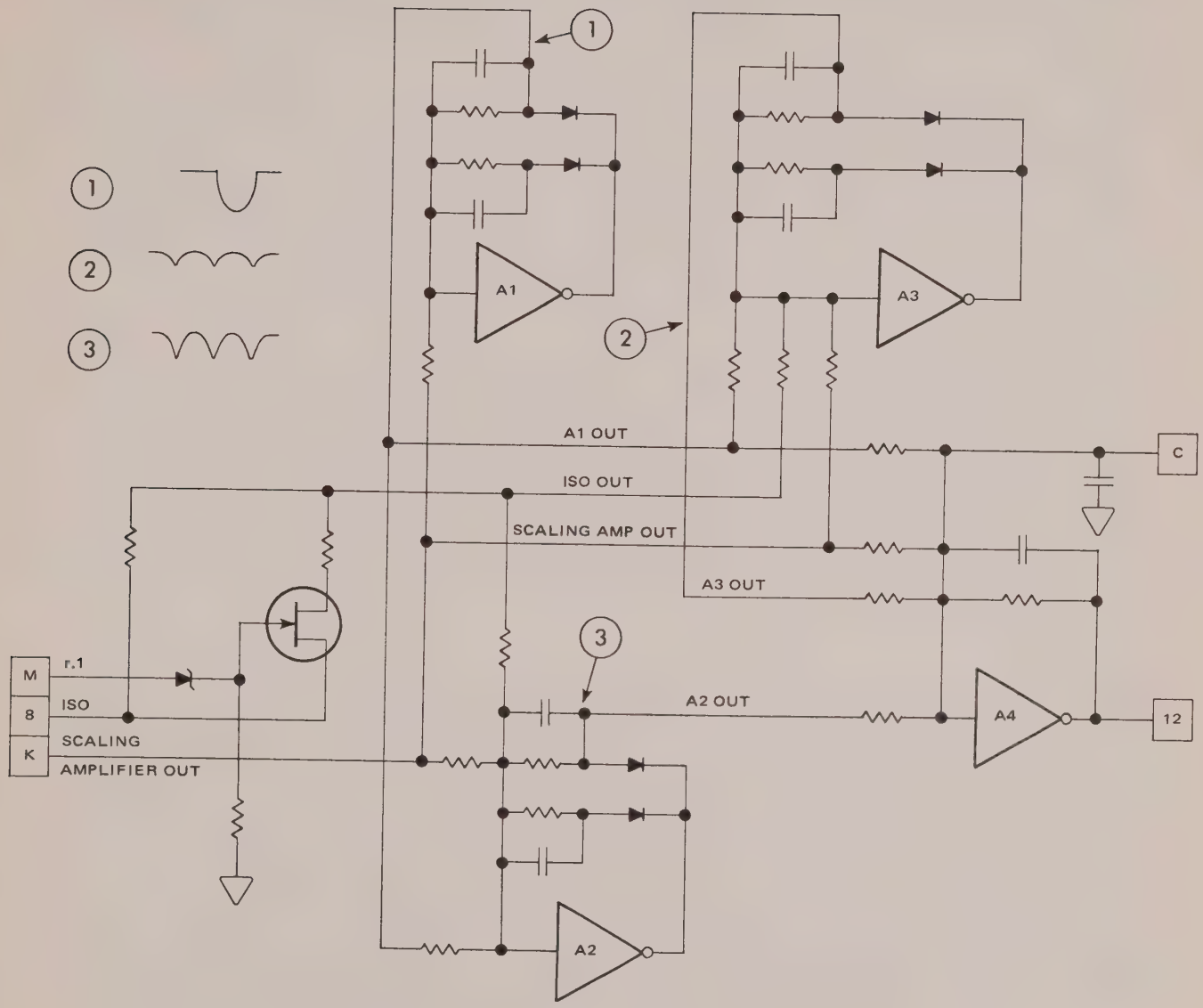


Figure 4.8 - Simplified Schematic — AC Converter

at the junction of the feedback path and the ground strap, a current that is equal to but subtracting from the current supplied by the feedback path.

4.31 AC OPTION. Two boards go into the measurement of AC signals, the Scaling Amplifier which isolates and scales down the input when necessary to produce a 1 volt RMS full-scale signal, and the converter which produces a DC equivalent of the scaled AC input signal. Refer to the simplified drawings of figures 4.7 and 4.8.

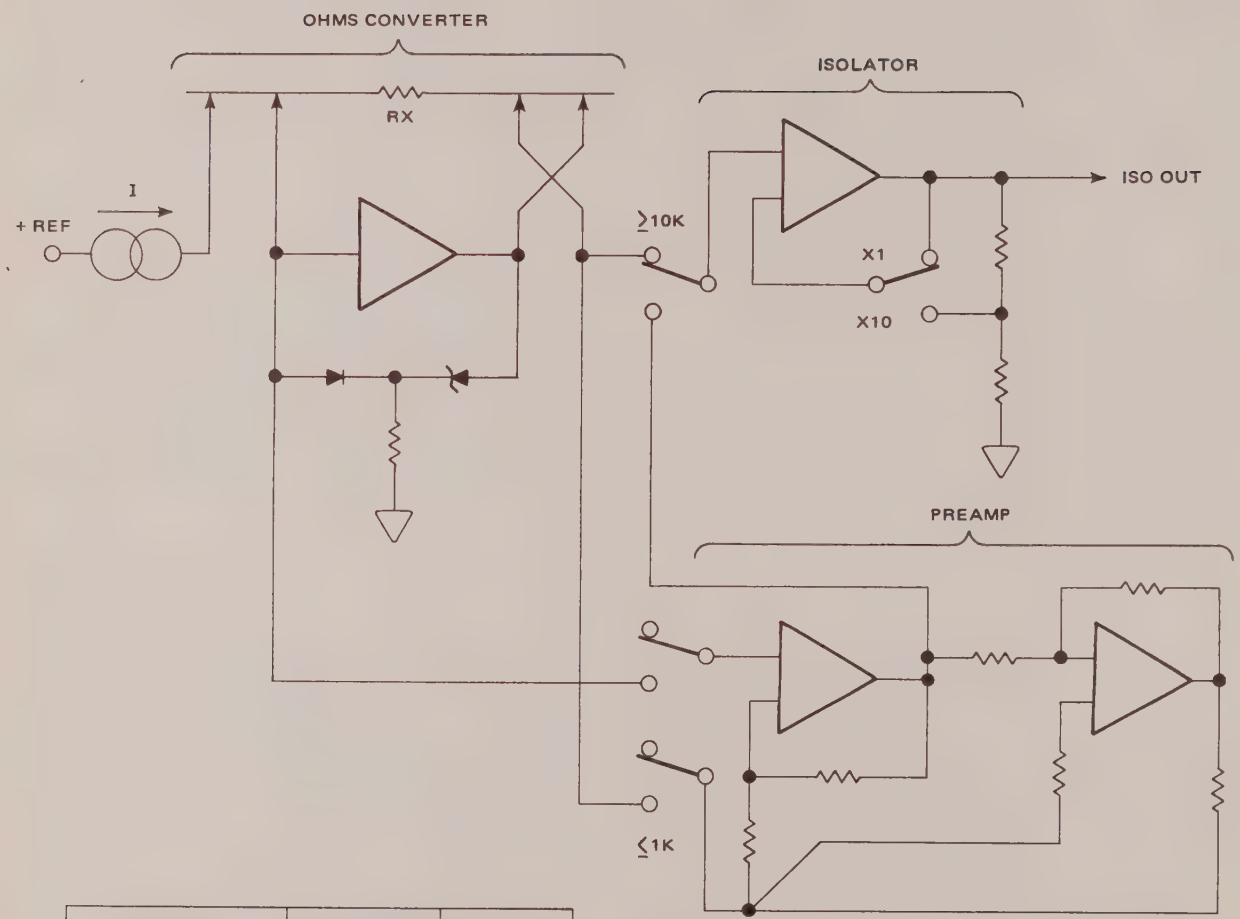
4.32 SCALING AMPLIFIER (403472). The scaling amplifier consists of an AC compensated operational amplifier with four possible gain settings (X1, X.1, X.01, and X.001). The range relays are driven by decoded data from the accessory range lines. On the R.1 and R1 ranges, additional roll off is provided the scaling amplifier by transistor Q1 for the X1 amplifier setting.

4.33 AC CONVERTER (403470). The AC converter uses the scaled output of the scaling amplifier along with the DVM isolator output (whose value is a function of the AC input) to produce a distortion insensitive dc equivalent of the AC input. The converter consists of three active rectifiers and one summing amplifier. Active rectifier A1 inverts and rectifies the scaled input. The output of A1 is taken from the negative going feedback diode producing a negative half wave signal. Active rectifier A2 sees inputs from the scaling amplifier, output A1 and the isolator output. The AC signal from the scaling amplifier combines with the A1 output signal to produce a full-wave rectified negative current to the input of A2 where is is inverted and rectified. The A2 output is taken from the negative going feedback diode. The isolator output biases A2 such that only a certain portion of the signal is allowed to appear at A2 output. Active rectifier A3 operates in precisely the same manner as A2 but with

a different amount of bias from the isolator. The summing amplifier sums and filters the outputs of the scaling amplifier and the three active rectifiers to produce the dc equivalent voltage. Full-scale output for the summing amplifier is +1 volt (.1 volt on the .1 volt range). The output is fed through the switching card to the isolator where, on the AC 1, 10, 100, and 1000 volt ranges. the isolator gain is at X10 and on the AC .1 volt range, the gain is X100.

4.34 OHMS/MILLIVOLT CONVERTER (403435). The Ohms converter permits DVM ohms measurement on nine ranges with full-scale readings from one ohm to 100 megohms. On each range a precise reference current is supplied to the resistance under test. The voltage developed across the resistance under test is amplified if required and measured by the DVM.

4.35 Referring to figure 4.6B, the converter consists of a current generator driving the summing node of an operational amplifier. Considering the summing node as a virtual ground the current developed by the current generator is equal to the equivalent resistance of the generator divided into the reference voltage (+10 volts). The current developed by the generator for each range is given in table 4.2. As shown in figure 4.9, the converter output is routed either through the preamplifier, or directly to the isolator. For ranges 10K through 100 Megohms, the current supplied by the generator produces 10 volts across the resistor under test when the resistance is equal to the full-scale value of the range selected (i.e., 100 kilohms on the 100K range, 10 kilohms on the 10K range, etc.). The voltage developed for full-scale resistances under test on the 10 ohm through the 1K ohm ranges is approximately 100 millivolts and on the one ohm range approximately 10 millivolts. For these ranges



RANGE	ISOLATOR	PREAMP
10K THROUGH 100 M	X1	NOT USED
10 Ω THROUGH 1K	X1	X99 (FIXED)
1 Ω	X10	X99 (FIXED)

Figure 4.9 - Functional Diagram, Ohms Measuring System

the + input of the preamp is connected to the summing node (effective ground) and the - input of the preamp is connected to the output of the op amp (through the - CURRENT lead). Connected in this configuration, the Preamplifier operates as an operational amplifier with the input impedance made effectively very high by the action of the current sink circuitry (see discussion of Preamplifier in paragraph 4.29). The gain of the preamp in this configuration is 99 (in contrast to the normal potentiometric gain of the preamp of 100). The current supplied by the current generator for the lower ranges are adjusted to compensate for the gain of the preamp not being a factor of 10. The values of the currents are given in table 4.2. On the one ohm range, the voltage, available for measurement with the Preamplifier included, is only one volt with full-scale resistance being measured (one ohm). The isolator therefore is set to the X10 position for this ohms range only to provide 10 volts full-scale to the DVM measuring circuitry.

Table 4.2 - Ohm Converter Current Generator

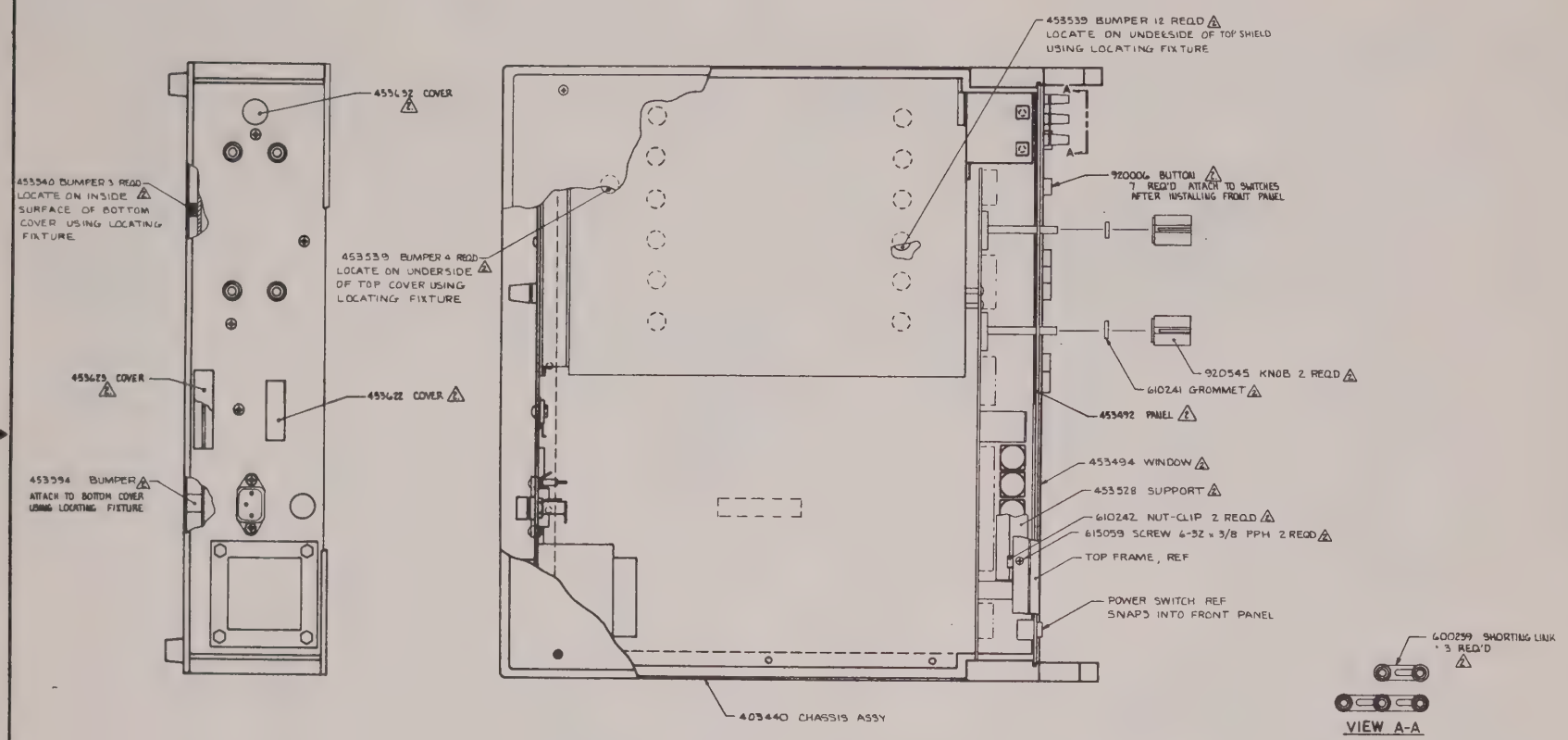
Range	Accessory Range Line	Converter Output Voltage, Full Scale	Current through Unknown	Current Generated By:	
100M	r100K	10V	.1 μA	Non-switched .1 μA (added to all other ranges)	
10M	r10K	10V	1 μA	+	K5 (.9 μA)
1M	r1K	10V	10 μA	+	K4 (9.9 μA)
100K	r100	10V	.1 mA	+	K3 (99.9 μA)
10K	r10	10V	1 mA	+	K1 (999.9 μA)
1K	r1	100 mV/.99	.10101 mA	+	K3 (99.9 μA + FET1 (1.01 μA)
100Ω	r.1	100 mV/.99	1.0101 mA	+	K1 (1 mA) + FET2 (X1.0101)
10Ω	r.01	100 mV/.99	10.101 mA	+	K1 (1 mA) + K2 (9 mA)
1Ω	r.001	10 mV/.99			+ FET2 (X1.0101)

SECTION 5

DRAWINGS

5.1 DRAWINGS.

400961	Model 4800 DVM Assembly
403433	Interconnection PCB Assembly
430958	Interconnection PCB Schematic
403430	Display PCB Assembly
430957	Display PCB Schematic
403432	Digitizer PCB Assembly
430949	Digitizer PCB Schematic
403434	Isolator PCB Assembly
430951	Isolator PCB Schematic
403464	MV PCB Assembly
430963	MV PCB Schematic
403435	MV-Ohms PCB Assembly
430950	MV-Ohms PCB Schematic
403431	Switching PCB Assembly
430952	Switching Schematic
403502	Rear Input Accessory
403470	AC Converter PCB Assembly
430964	AC Converter PCB Schematic
403472	Scaling Amplifier PCB Assembly
430966	Scaling Amplifier PCB Schematic
403436	Program PCB Assembly
430959	Program PCB Schematic


453539 BUMPER 12 REQD
LOCATE ON UNDERSIDE OF TOP SHIELD USING LOCATING FIXTURE
459632 COVER
453540 BUMPER 3 REQD LOCATE ON INSIDE SURFACE OF BOTTOM COVER USING LOCATING FIXTURE
453539 BUMPER 4 REQD LOCATE ON UNDERSIDE OF TOP COVER USING LOCATING FIXTURE
920006 BUTTON 7 REQ'D ATTACH TO SWITCHES AFTER INSTALLING FRONT PANEL
920545 KNOB 2 REQD
610241 GROMMET
453492 PANEL
453494 WINDOW
453528 SUPPORT
610242 NUT-CLIP 2 REQD
615059 SCREW 6-32 x 3/8 PPH 2 REQD
TOP FRAME, REF
POWER SWITCH REF SNAPS INTO FRONT PANEL
453623 COVER
453622 COVER
453394 BUMPER ATTACH TO BOTTOM COVER USING LOCATING FIXTURE
403440 CHASSIS ASSY
600259 SHORTING LINK 3 REQ'D
VIEW A-A

PART OF FINISHING KIT 403439

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

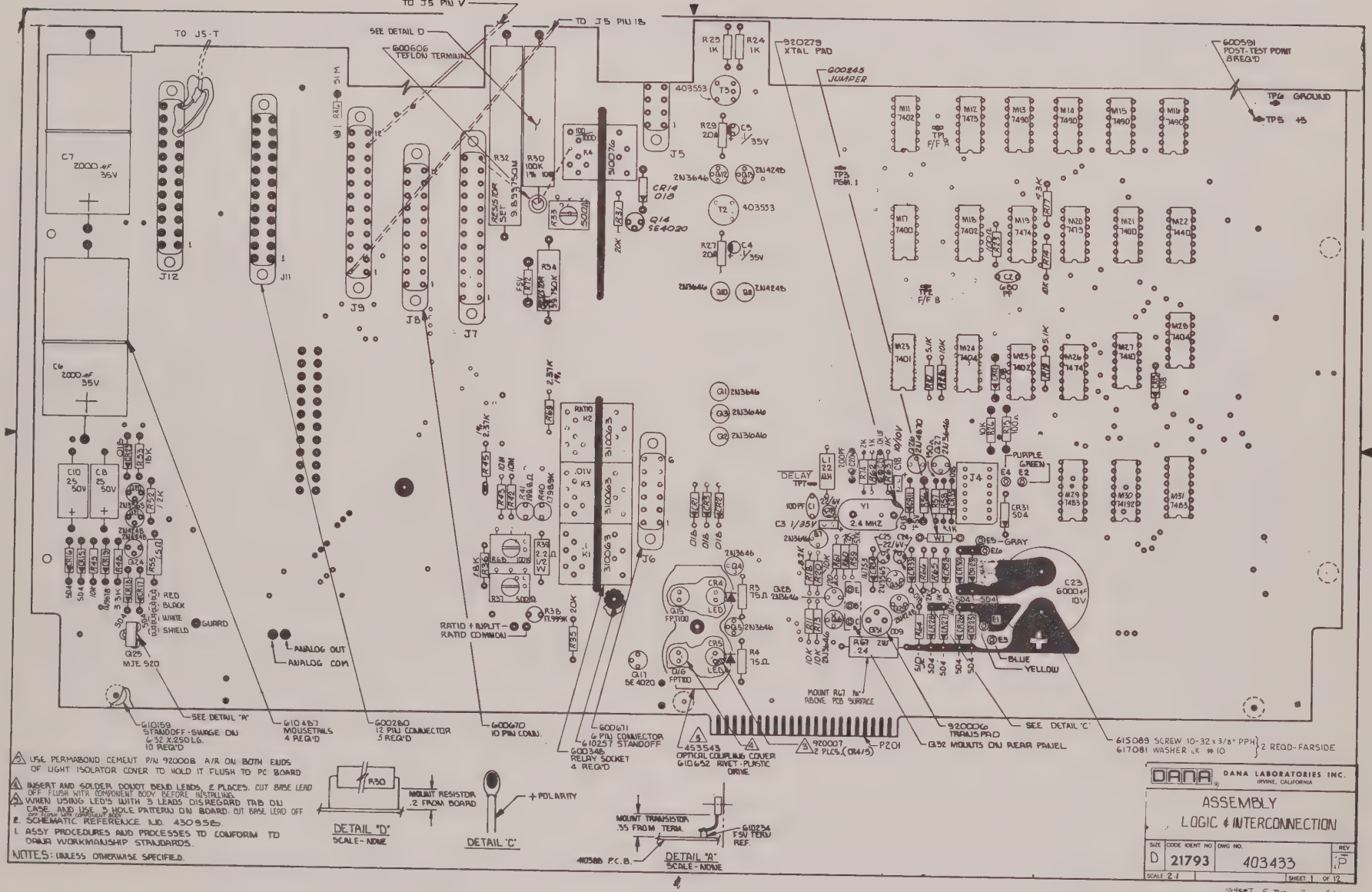
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

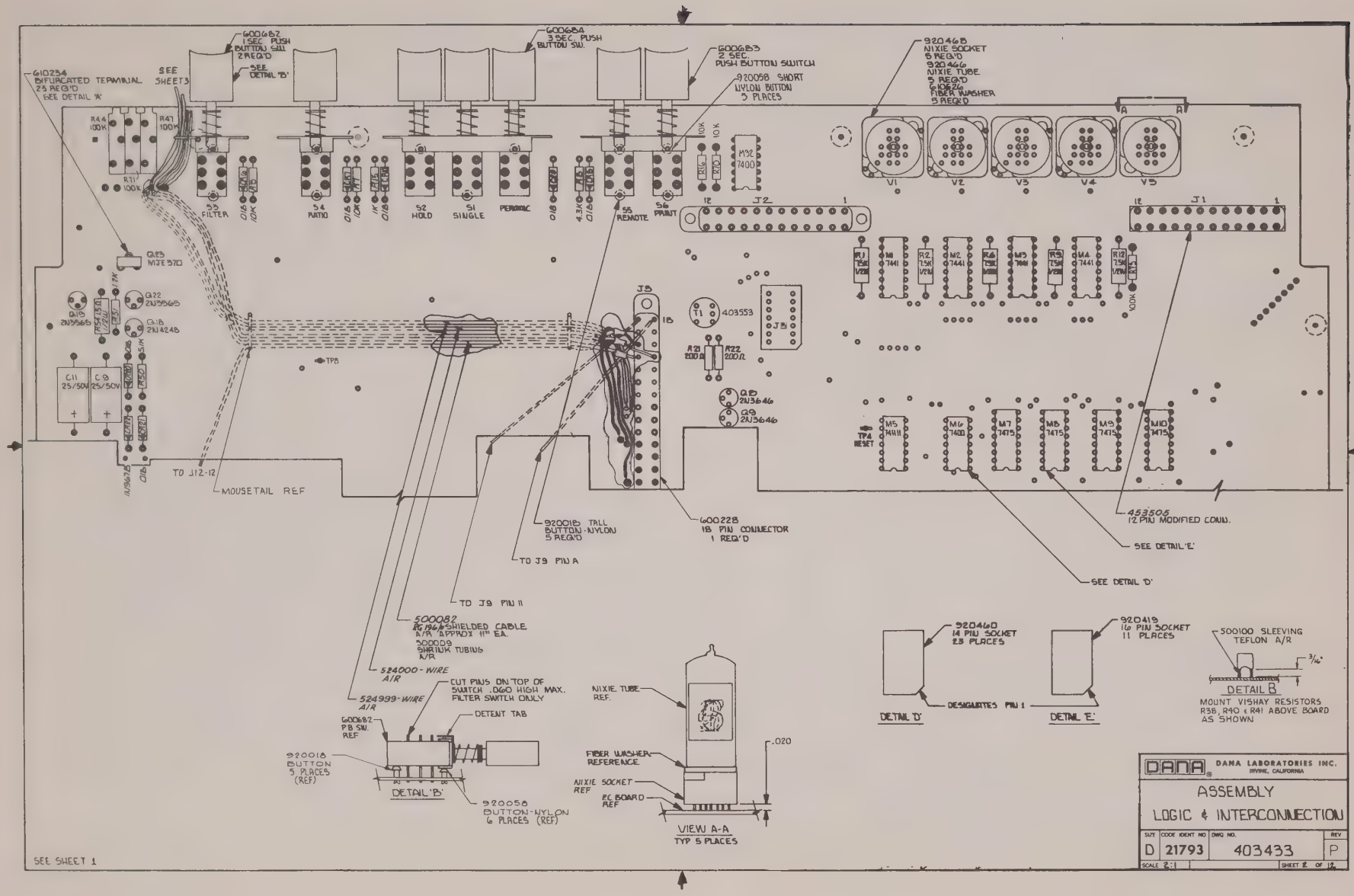
ASSEMBLY- DVM 4800

SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	400961	E

SCALE NONE SHEET 1 OF 2

SHEET 2 IS AN 'A' SIZE


TO J5 PIN V
TO J5 PIN 18
TO J5-T
SEE DETAIL D
600606 TEFLON TERMINAL
920279 XTAL PAD
600845 JUMPER
600591 POST-TEST POINT BREQ'D
TP6 GROUND
TP5 +5
J12
J11
J9
J8
J7
J5
J6
J4
C7 2000 uF 35V
C6 2000 uF 35V
C10 25 50V
C8 25 50V
R25 1K
R24 1K
R32
R30 100K 1% 100
RESISTOR SET 9.8975OHM
R35 500HM
R34 750K
R31 20K
CR14 D18
Q14 SE4020
T3 403553
T2 403553
T1 403553
R29 20
R27 20
C5 35V
C4 35V
2N3646
2N4249
F/F A
F/F B
F/F C
M11 7402
M12 7475
M13 7490
M14 7490
M15 7490
M16 7490
M17 7400
M18 7402
M19 7474
M20 7413
M21 7400
M22 7440
M23 7401
M24 7404
M25 7402
M26 7474
M27 7410
M28 7404
M29 7453
M30 74192
M31 7463
C2 .001
C3 1/35V
C1 100PF
Y1 2.4 MHZ
C25 22/6V
C24 .02
C23 6000 uF 10V
W1
CR31 504
DELAY TPT
ENC
PURPLE
GREEN
GRAY
BLUE
YELLOW
RED
BLACK
WHITE
SHIELD
GUARD
Q25 MJE 520
ANALOG OUT
ANALOG COM
RATIO + INPUT
RATIO COMMON
K2 .1
K3 .01
K4 1
3100763
3100663
Q11 2N3646
Q13 2N3640
Q12 2N3640
Q15 FPT100
Q16 FPT100
CR4 LED
CR5 LED
Q17 SE4020
Q18 2N3646
Q19 2N3646
Q20 2N3646
Q21 2N3646
Q22 2N3646
Q23 2N3646
Q24 2N3646
Q26 2N4870
Q27 2N3646
Q28 2N3646
Q29 2N3646
Q30 2N3646
Q31 2N3646
Q32 2N3646
Q33 2N3646
Q34 2N3646
Q35 2N3646
Q36 2N3646
Q37 2N3646
Q38 2N3646
Q39 2N3646
Q40 2N3646
Q41 2N3646
Q42 2N3640
Q43 2N3646
Q44 2N3646
Q45 2N3646
Q46 2N3646
Q47 2N3646
Q48 2N3646
Q49 2N3646
Q50 2N3646
Q51 2N3646
Q52 2N3646
Q53 2N3646
Q54 2N3646
Q55 2N3646
Q56 2N3646
Q57 2N3646
Q58 2N3646
Q59 2N3646
Q60 2N3646
Q61 2N3646
Q62 2N3646

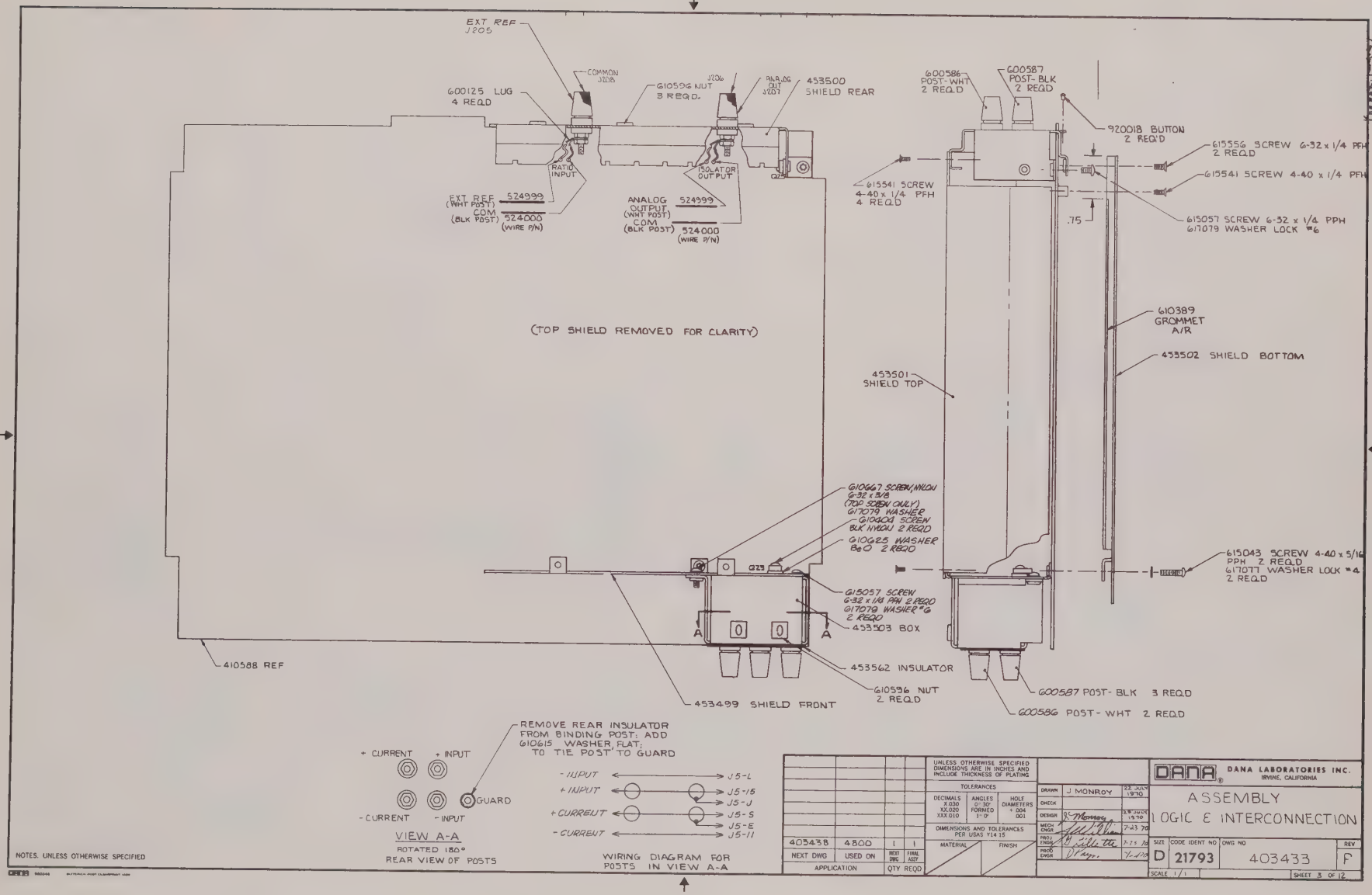


DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

ASSEMBLY LOGIC & INTERCONNECTION

SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	403433	P

SCALE 2:1 SHEET 2 OF 12


EXT REF J205
COMMON J208
ANALOG OUT J207
610596 NUT 3 REQ'D.
453500 SHIELD REAR
600125 LUG 4 REQ'D
600586 POST-WHT 2 REQ'D
600587 POST-BLK 2 REQ'D
920018 BUTTON 2 REQ'D
615556 SCREW 6-32 x 1/4 PPH 2 REQ'D
615541 SCREW 4-40 x 1/4 PPH
615057 SCREW 6-32 x 1/4 PPH 617079 WASHER LOCK #6
RATIO INPUT
ISOLATOR OUTPUT
EXT REF (WHT POST) 524999
COM (BLK POST) 524000 (WIRE P/N)
ANALOG OUTPUT (WHT POST) 524999
COM (BLK POST) 524000 (WIRE P/N)
615541 SCREW 4-40 x 1/4 PPH 4 REQ'D
.15
(TOP SHIELD REMOVED FOR CLARITY)
610389 GROMMET A/R
453502 SHIELD BOTTOM
453501 SHIELD TOP
610667 SCREW NYLON 6-32 x 3/8 (TOP SCREW ONLY) 617079 WASHER
610404 SCREW BLK NYLON 2 REQ'D
610625 WASHER 860 2 REQ'D
615043 SCREW 4-40 x 5/16 PPH 2 REQ'D 617077 WASHER LOCK #4 2 REQ'D
615057 SCREW 6-32 x 1/2 PPH 2 REQ'D 617079 WASHER #6 2 REQ'D
453503 BOX
410588 REF
453562 INSULATOR
610596 NUT 2 REQ'D
600587 POST- BLK 3 REQ'D
600586 POST- WHT 2 REQ'D
453499 SHIELD FRONT
REMOVE REAR INSULATOR FROM BINDING POST; ADD 610615 WASHER, FLAT; TO TIE POST TO GUARD
+ CURRENT
+ INPUT
GUARD
- CURRENT
- INPUT
VIEW A-A
ROTATED 180°
REAR VIEW OF POSTS
- INPUT J5-L
+ INPUT J5-15
J5-J
+ CURRENT J5-S
J5-E
- CURRENT J5-11
WIRING DIAGRAM FOR POSTS IN VIEW A-A

NOTES. UNLESS OTHERWISE SPECIFIED

403438	4800	1	1
NEXT DWG	USED ON	NEXT DWG	FINAL ASY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	+ .004
XX .020	FORMED	- .001
XXX .010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.5

MATERIAL | FINISH

DRAWN	J MONROY	23 JULY 1970
CHECK		
DESIGN	J. Monroy	23 JULY 1970
MECH ENGR		7-23-70
PROJ ENGR		7-15-70
PROD ENGR		7-17-70

DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

ASSEMBLY LOGIC & INTERCONNECTION

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	403433	F

SCALE 1/1 SHEET 3 OF 12

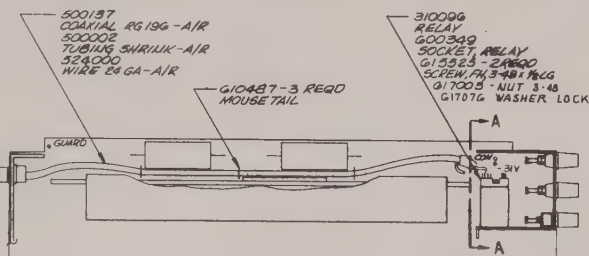
REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
	RELEASED PER DAN #			

500137
COAXIAL RG196-A/R
500002
TUBING SHRINK-A/R
524000
WIRE 24 GA-A/R

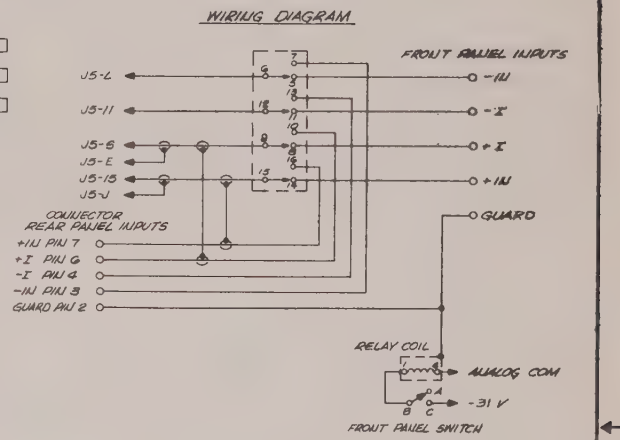
G10487-3 REQD
MOUSE TAIL

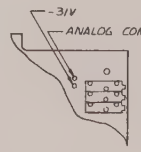
310096
RELAY
600349
SOCKET, RELAY
613823-2 REQD
SCREW, FH, 3-48 x 1/4 LG
617005 - NUT 3-48
617076 WASHER LOCK

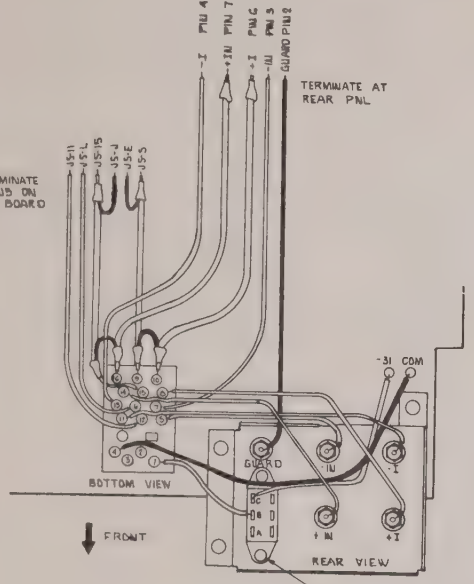
600673
CONJUCTOR
600672
CONNECTOR PINS, 7 REQD



WIRING DIAGRAM







VIEW A-A
WIRING DETAIL
NO SCALE

920457 SWITCH
615526 SCR 3-48 x 3/4 LG
617076 #3 LK WASH
617005 #3 HEX NUT
2 REQD ⚠

⚠. USE LOCTITE 92005 ON SCREWS.

NOTES: UNLESS OTHERWISE SPECIFIED

403438	4800	1	1
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	± .004
XX .020	FORMED	- .001
XXX .010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL / FINISH

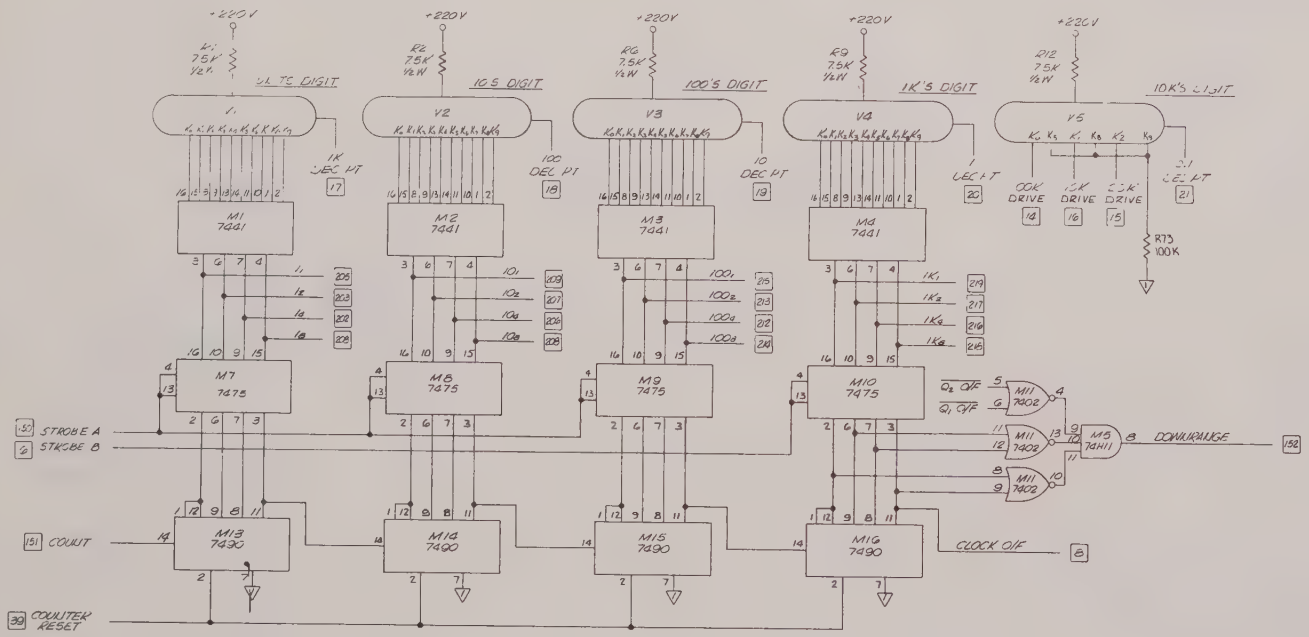
DRAWN	L. AUSMAN	4-7-71
CHECK		
DESIGN		
MATCH ENGR		
PROJ ENGR		
PROD ENGR		

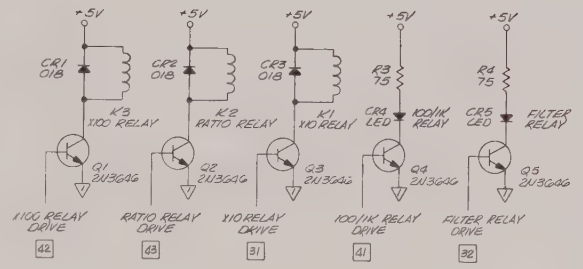
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY LOGIC & INTERCONNECTION

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403433	P

SCALE NONE | SHEET 4 OF 12





10. ☐ INDICATES CONNECTIONS
    1-48 — J1, J2
    100-109 — J3
    150-160 — INTERCONNECTION
    200-219 — P201
9. ANALOG COMMON IS TIED TO MECCA

(8) TRANSISTOR TO BE MOUNTED TO REAR PANEL

7. 74192, Vcc 15 ON PIN 16 & GND 5 ON PIN 8
6. 7490, Vcc 15 ON PIN 5 & GND 10 ON PIN 10
5. 7473, Vcc 15 ON PIN 4 & GND 13 ON PIN 11
4. 7441, 7475, 7483, Vcc 15 ON PIN 5 & GND 15 ON PIN 12
3. 7400, 7401, 7402, 7404, 74H11, 7410, 7420 7474, Vcc 15 ON PIN 10 & GND 15 ON PIN 7
2. GROUND (2) DESIGNATES ANALOG GROUND
1. GROUND (1) DESIGNATES DIGITAL GROUND

NOTES: UNLESS OTHERWISE SPECIFIED

603433	4800		
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X.030	0° 30'	+.004
XX.020	FORMED	-.001
XXX.010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL | FINISH

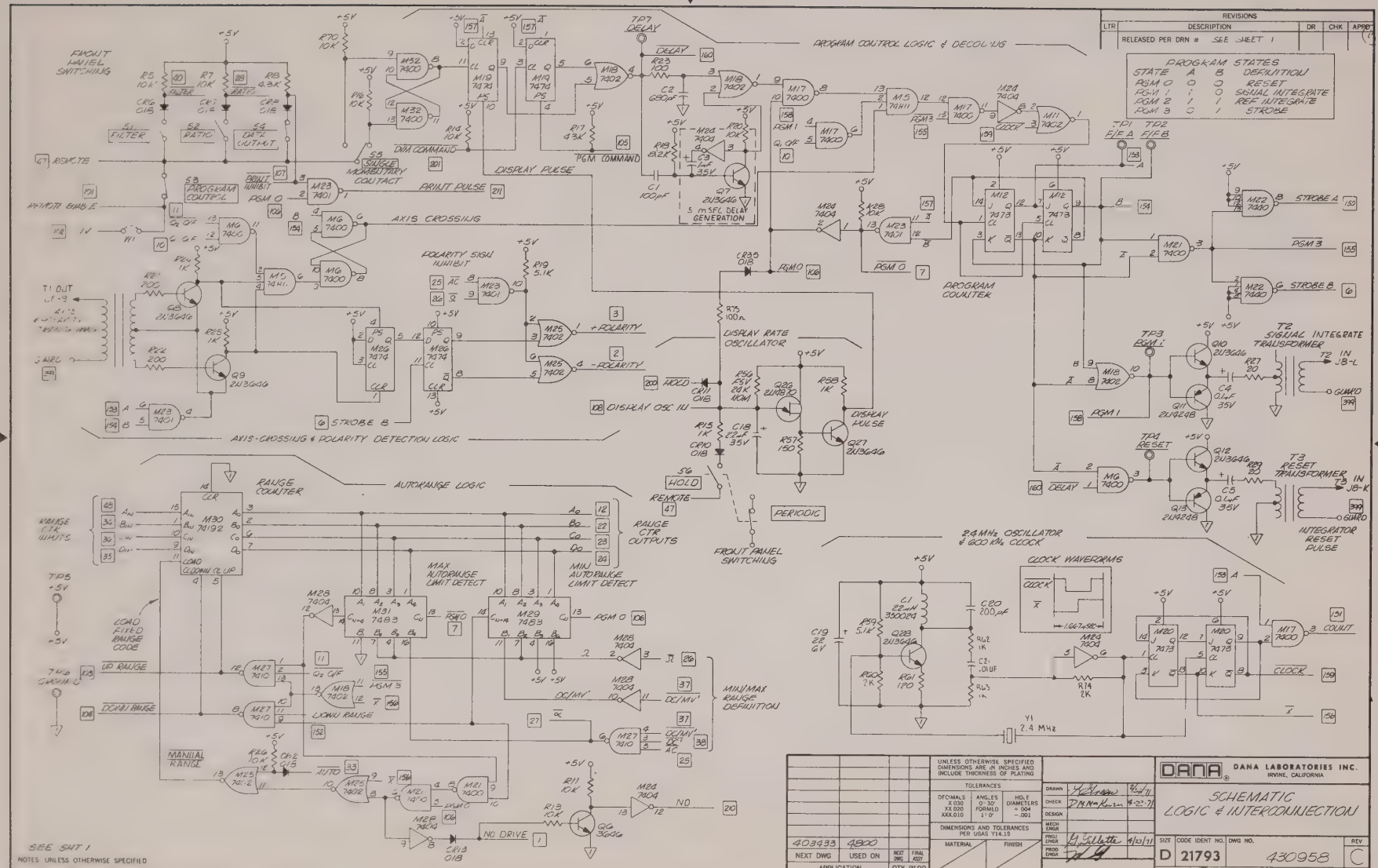
DRAWN	K. Hansen	8/23/71
CHECK	D. M. Mankins	8/27/71
DESIGN		
MECH. ENGR.		
PROJ. ENGR.	G. Gillette	9/23/71
PROD. ENGR.		11/2/71

DANA (IA) DANA LABORATORIES INC. IRVINE CALIFORNIA

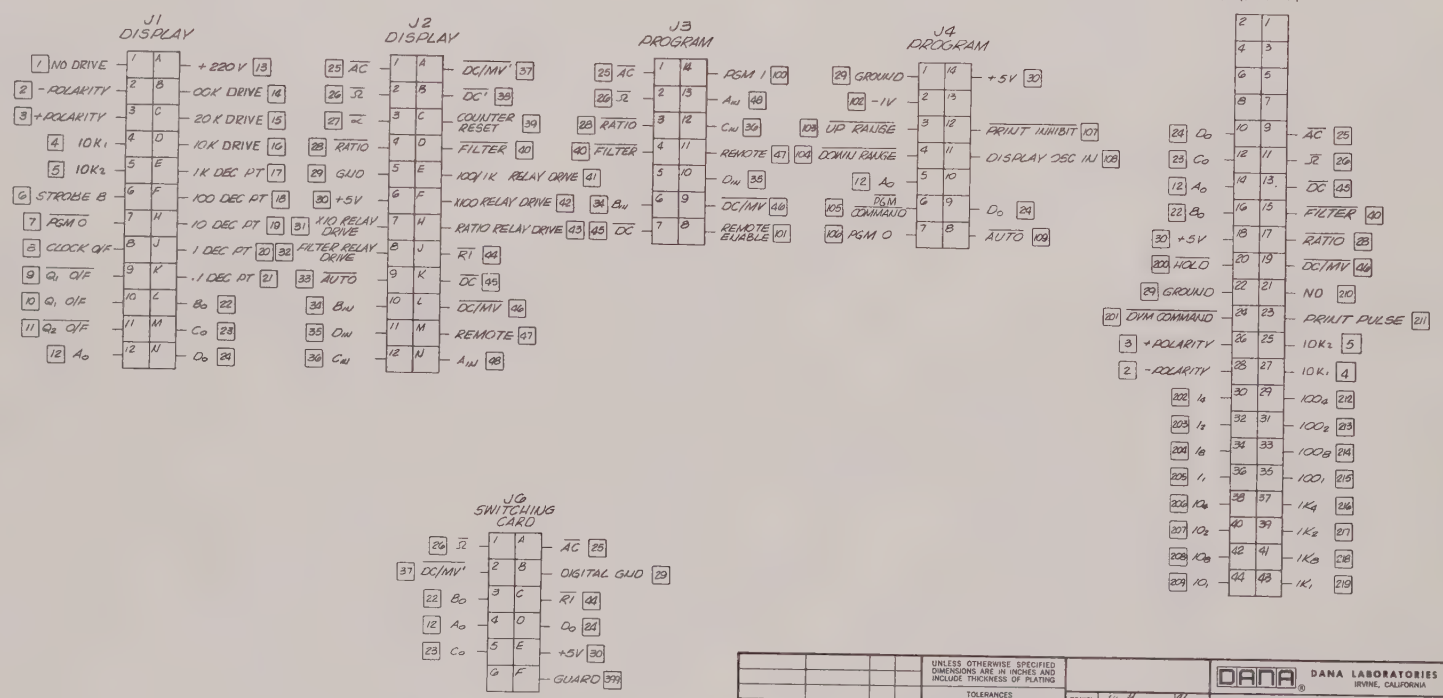
SCHEMATIC LOGIC & INTERCONNECTION

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	430958	C

SCALE | SHEET 1 OF 5


REVISIONS
LTR DESCRIPTION DR CHK APPD
RELEASED PER DRN # SEE SHEET 1
PROGRAM STATES
STATE A B DEFINITION
PGM 0 0 0 RESET
PGM 1 1 0 SIGNAL INTEGRATE
PGM 2 1 1 REF INTEGRATE
PGM 3 0 1 STROBE
PROGRAM CONTROL LOGIC & DECODING
AXIS-CROSSING & POLARITY DETECTION LOGIC
AUTORANGE LOGIC
2.4 MHz OSCILLATOR & 600 kHz CLOCK
FRONT PANEL SWITCHING
DISPLAY RATE OSCILLATOR
PROGRAM COUNTER
CLOCK WAVEFORMS
SEE SHT 1
NOTES UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC
LOGIC & INTERCONNECTION
SIZE D
CODE IDENT NO. 21793
DWG NO. 430958
REV C
SCALE
SHEET 2 OF 5
403933 4800
NEXT DWG USED ON
APPLICATION
QTY REQD

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
	RELEASED PER DRN # SEE SHEET 1			



SEE SHT 1
NOTES UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	.004
XX .020	FORMED	-.001
XXX .010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL / FINISH

DRAWN	[illegible]	9/24/71
CHECK	DM McKenzie	9-23-71
DESIGN		
MECH ENGR		
PROJ ENGR	G. Gillette	9/23/71
PROD ENGR		

403433	9800		
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

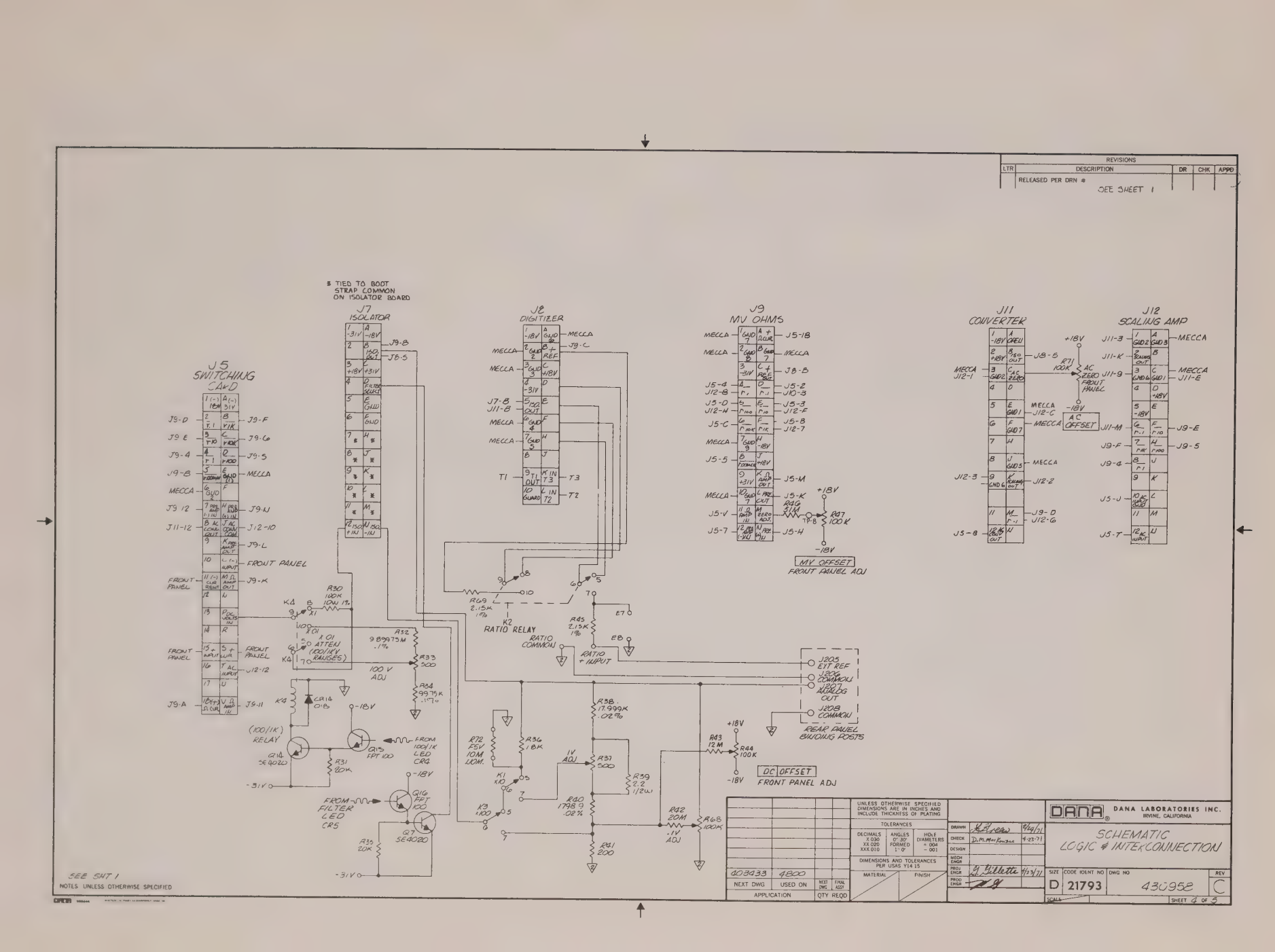
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC LOGIC & INTERCONNECTION

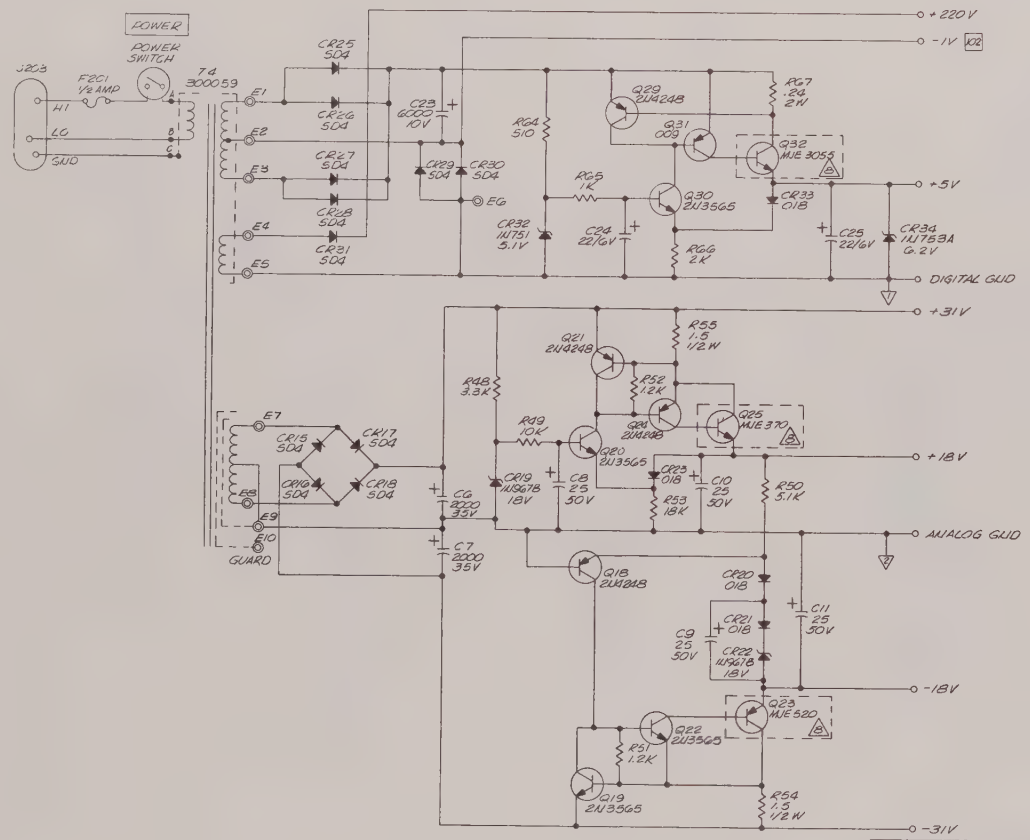
SIZE	CODE IDENT NO	DWG NO	REV
D	21793	430988	C

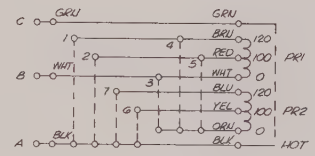
SCALE

SHEET 3 OF 5


REVISIONS
LTR DESCRIPTION DR CHK APPD
RELEASED PER DRN #
SEE SHEET 1
* TIED TO BOOT STRAP COMMON ON ISOLATOR BOARD
J5 SWITCHING CARD
J7 ISOLATOR
J8 DIGITIZER
J9 MV OHMS
J11 CONVERTER
J12 SCALING AMP
FRONT PANEL
REAR PANEL BINDING POSTS
J20S EXT REF
J20G COMMON/ XDRDG OUT
J20B COMMON
K1 RATIO RELAY
K2 (100/1K) RELAY
K3
K4
RATIO COMMON
RATIO + INPUT
MV OFFSET FRONT PANEL ADJ
DC OFFSET FRONT PANEL ADJ
AC ZERO FRONT PANEL
AC OFFSET
1V ADJ
100 V ADJ
FROM 100/1K LED CRQ
FROM FILTER LED CRS
SEE SHT 1
NOTES UNLESS OTHERWISE SPECIFIED
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING
TOLERANCES
DECIMALS X.030 XX.020 XXX.010
ANGLES 0° 30' FORMED 1° 0'
HOLE DIAMETERS ± .004 - .001
DIMENSIONS AND TOLERANCES PER USAS Y14.15
MATERIAL FINISH
NEXT DWG USED ON APPLICATION
NEXT ASSY FINAL ASSY QTY REQD
DRAWN K.P. Lee 9/4/71
CHECK D.M. Montanez 9-23-71
DESIGN
MECH ENGR
PROJ ENGR G. Gillette 9/23/71
PROD ENGR
DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA
SCHEMATIC LOGIC & INTERCONNECTION
SIZE D CODE IDENT NO 21793 DWG NO 430952 REV C
SCALE SHEET 4 OF 5

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
	RELEASED PER DRN # SEE SHEET 1			





LINE VOLTAGE	JUMPER
100 V	2-3-6
120 V	1-3-7
200 V	5-6
220 V	4-6
240 V	4-7

T4 EXPORT OPTION (300066)

SEE SHT 1
NOTES. UNLESS OTHERWISE SPECIFIED

403033	4800		
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	+.004
XX .020	FORMED	-.001
XXX .010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL | FINISH

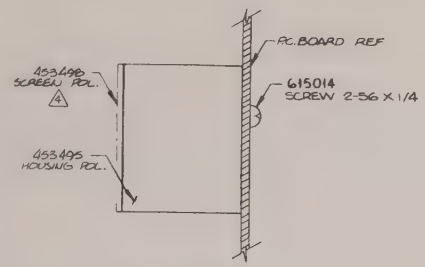
DRAWN	[illegible]	11/29/71
CHECK	D. M. M.	4-25-71
DESIGN		
MECH ENGR		
PROJ ENGR	L. Elliott	9/23/71
PROD ENGR		

DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

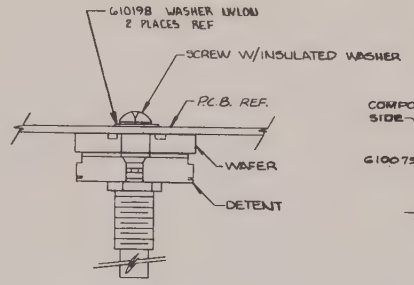
SCHEMATIC
LOGIC & INTERCONNECTION

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	430958	C

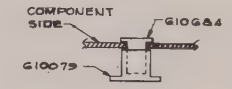
SCALE | SHEET 5 OF 5



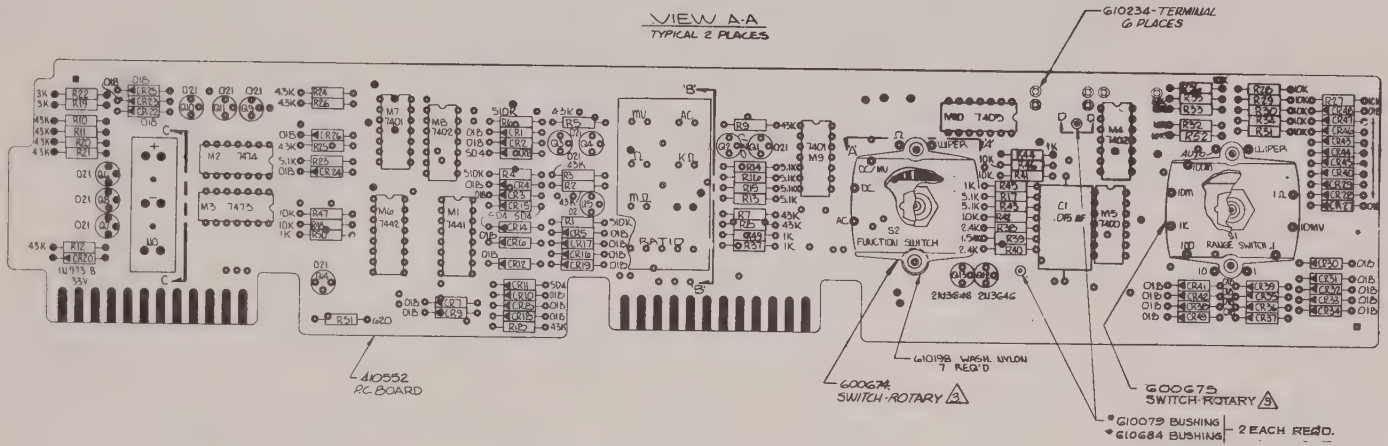
VIEW C-C

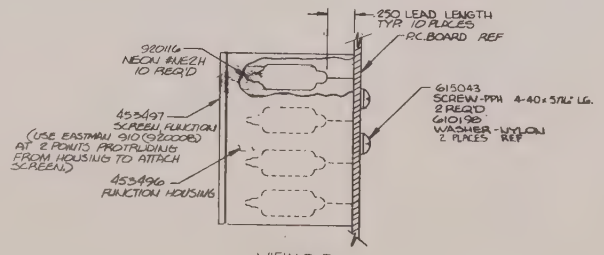


VIEW A-A
TYPICAL 2 PLACES



VIEW D-D,
TYPICAL 2 PLACES





VIEW B-B

⚠ USE EASTMAN 910 PMS 920000B AT 2 POINTS PROTRUDING FROM HOUSING TO ATTACH POLARITY SCREEN.

⚠ DETENT PART OF SWITCH SHALL BE TURNED FULL COUNTER CLOCK WISE BEFORE FINAL MATING WITH WAFER.

C SCHEMATIC REF. # 450957

ASSY PROCESSES AND PROCEDURES TO CONFORM TO ANA WORKMANSHIP STANDARDS.

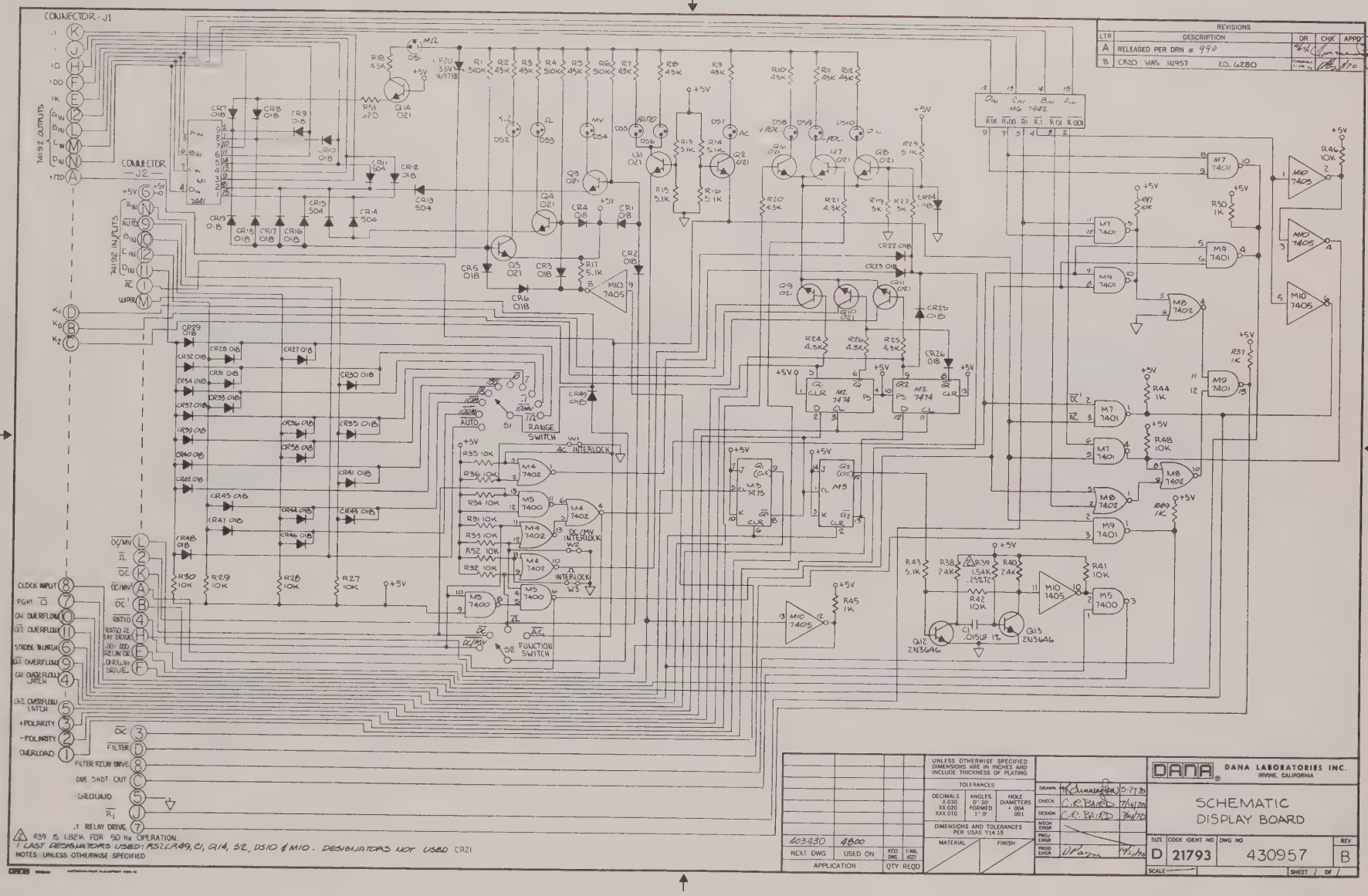
NOTES: UNLESS OTHERWISE SPECIFIED

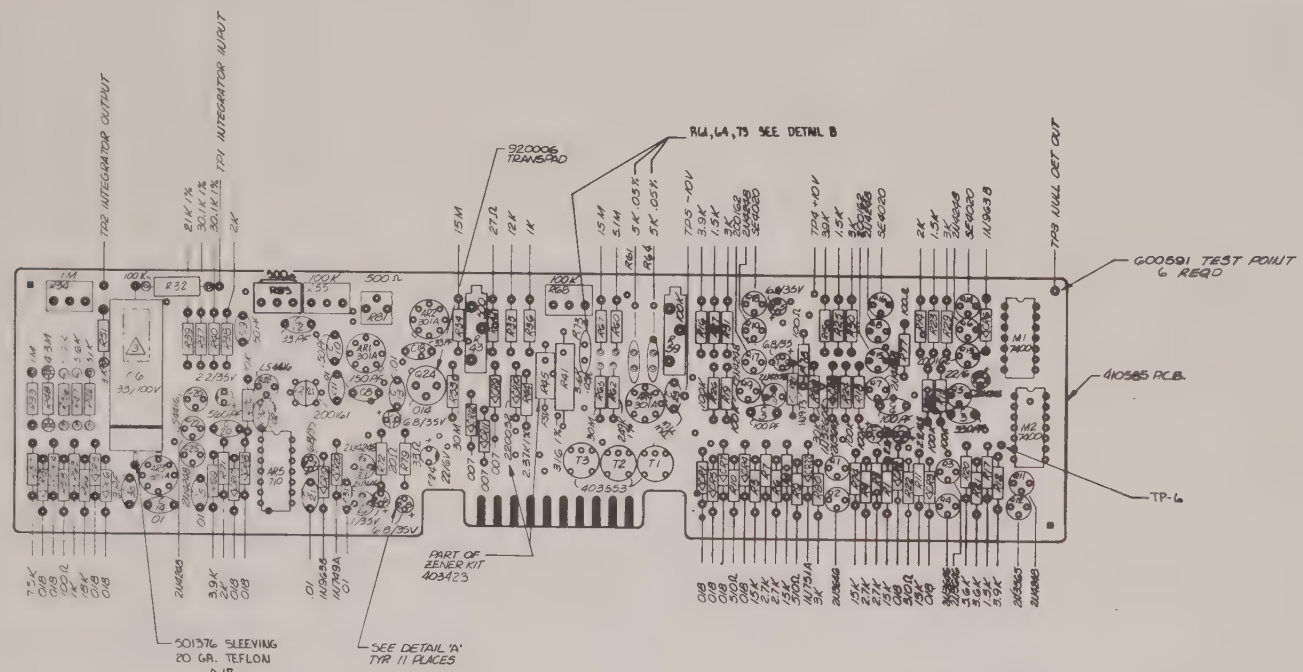
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSY
DISPLAY BOARD

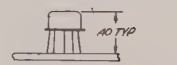
SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	403430	J

SCALE 2:1 SHEET 1 OF 4


CONNECTOR - J1
74192 OUTPUTS
74192 INPUTS
CONNECTOR - J2
RANGE SWITCH
AC INTERLOCK
DC/MV INTERLOCK
DC INTERLOCK
FUNCTION SWITCH
CLOCK INPUT
PGM
ON OVERFLOW
G2 OVERFLOW
STROBE BLANKING
G1 OVERFLOW
G0 OVERFLOW LATCH
G2 OVERFLOW LATCH
+POLARITY
-POLARITY
OVERLOAD
FILTER
FILTER RELAY DRIVE
ONE SHOT OUT
GROUND
RELAY DRIVE
R39 IS 1.82K FOR 50 Hz OPERATION.
LAST RESIGNATORS USED: R52, CR49, C1, Q14, S2, DS10 & M10. DESIGNATORS NOT USED CR21
NOTES: UNLESS OTHERWISE SPECIFIED
REVISIONS
LTR DESCRIPTION DR CHK APPD
A RELEASED PER DRN # 990
B CR20 WAS 114957 ED. 6280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING
TOLERANCES
DECIMALS X .030 XX .020 XXX .010
ANGLES ± 30' FORMED 1° 0'
HOLE DIAMETERS + .004 - .001
DIMENSIONS AND TOLERANCES PER USAS Y14.15
MATERIAL
FINISH
DRAWN
CHECK C.R. BAIRD
DESIGN C.R. BAIRD
MECH ENGR
PROJ ENGR
PROD ENGR
403430 NEXT DWG
4800 USED ON
APPLICATION
QTY REQD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC
DISPLAY BOARD
SIZE D
CODE IDENT NO 21793
DWG NO 430957
REV B
SCALE
SHEET / OF



DETAIL "A"



TYP FOR AR1, AR2, AR3, AR4

DETAIL D

MOUNT UNDER RESISTORS R44,64 & 73 INSIDE PCB AS SHOWN.

⚠ PLACE ZENER STICKER PART 403423 TEST ON TOP OF CG

SCHEMATIC REF # 450349

ASSEMBLY PROCESSES & PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

NOTES: UNLESS OTHERWISE NOTED

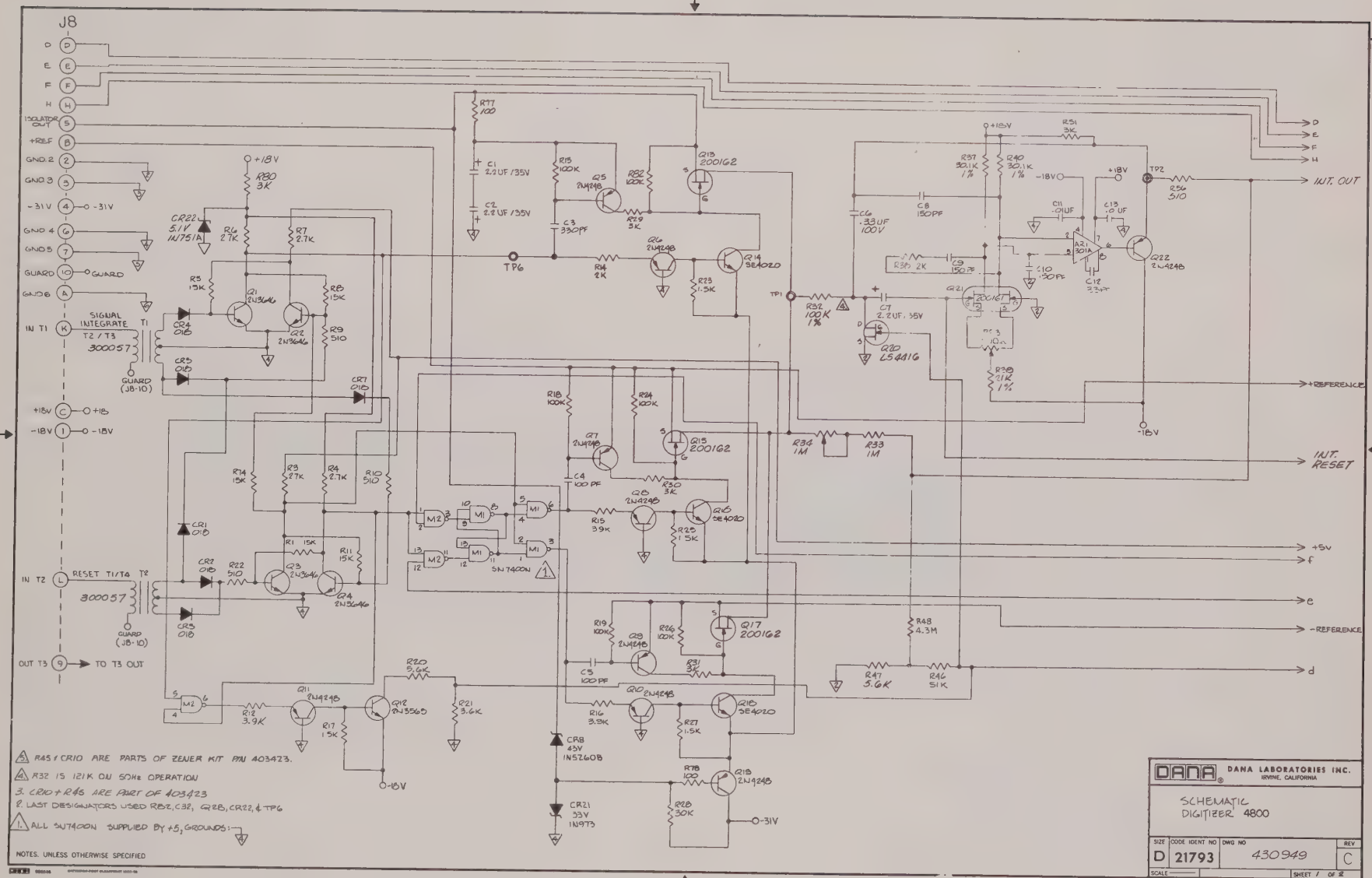
DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

ASSEMBLY
DIGITIZER

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	403432	J

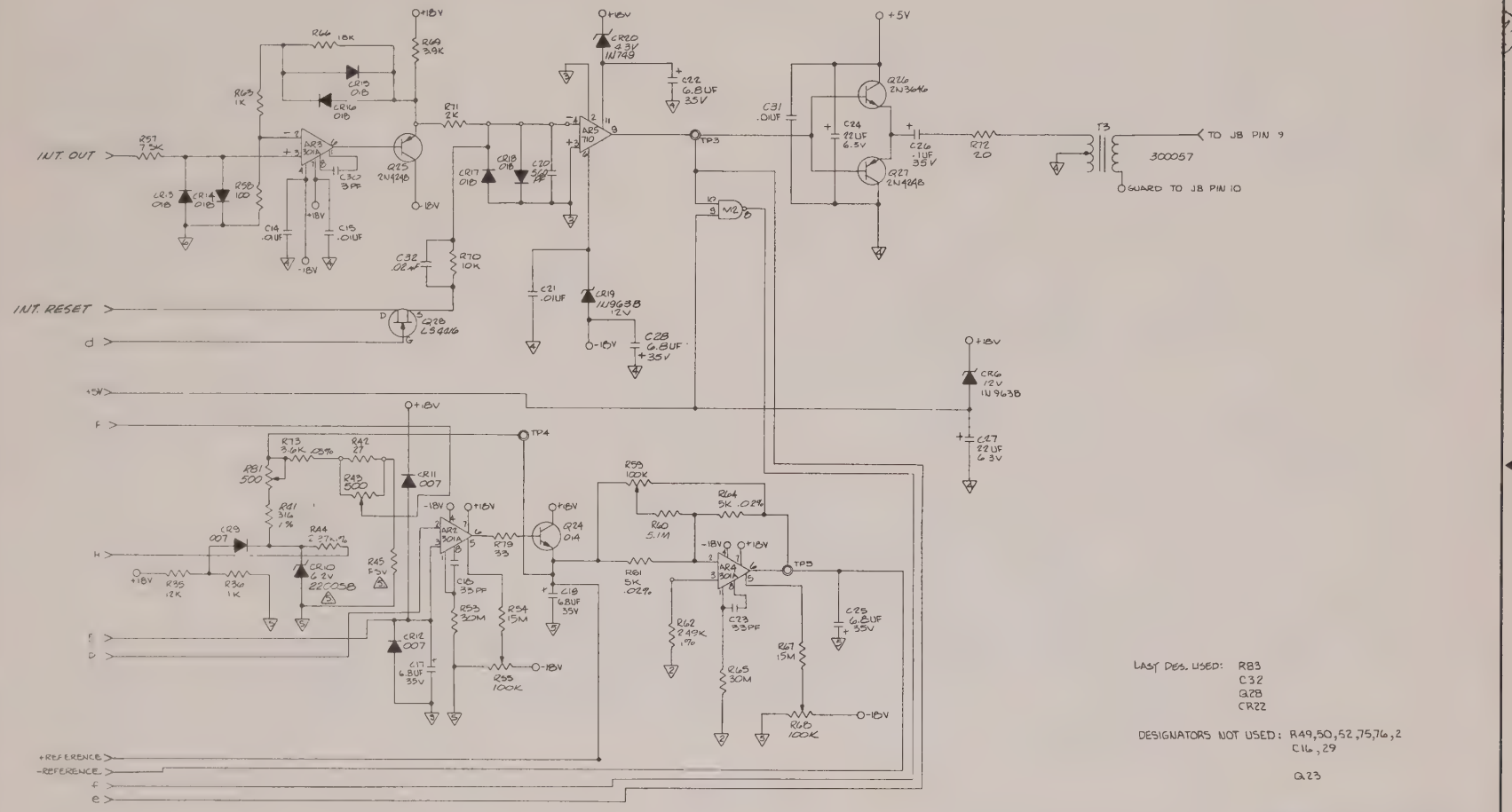
SCALE 2:1 SHEET 1 OF 5

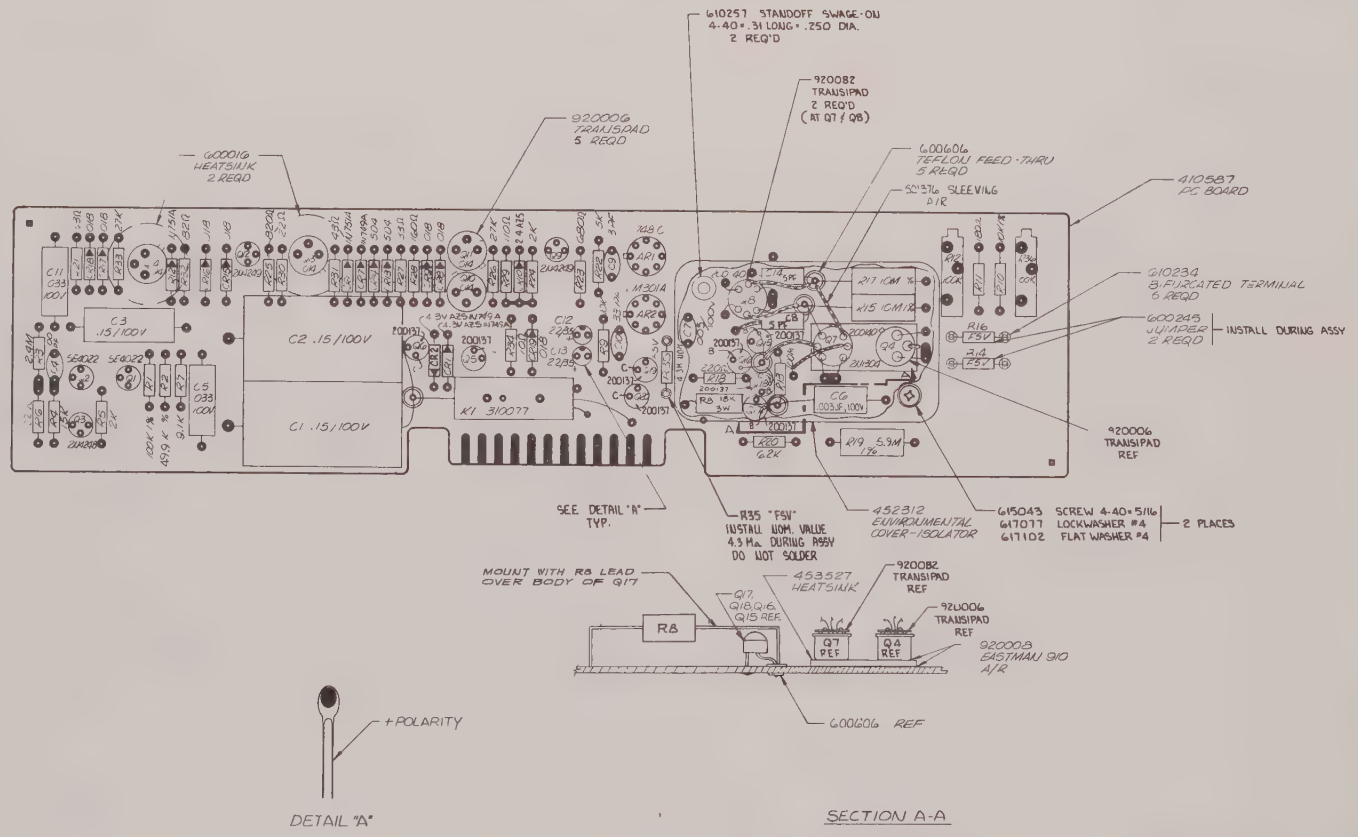
SHEETS 2 THRU 5 ARE A SIZE



NOTES. UNLESS OTHERWISE SPECIFIED

1. ALL SN7400N SUPPLIED BY +5, GROUNDS:
2. LAST DESIGNATORS USED R82, C32, Q28, CR22, & TP6
3. CR10 + R45 ARE PART OF 403423
4. R32 IS 121K ON 50Hz OPERATION
5. R45 & CR10 ARE PARTS OF ZENER KIT PN 403423.


INT. OUT
INT. RESET
d
+5V
F
H
E
D
+REFERENCE
-REFERENCE
f
e
+18V
-18V
TP3
TP4
TP5
TO JB PIN 9
GUARD TO JB PIN 10
300057
LAST DES. USED: R83
C32
Q28
CR22
DESIGNATORS NOT USED: R49,50,52,75,76,2
C16,29
Q23
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC
DIGITIZER 4800
SIZE D
CODE IDENT NO 21793
DWG NO 430949
REV C
SCALE
SHEET 2 OF 2
SEE SHEET 1.
NOTES UNLESS OTHERWISE SPECIFIED



3 SCHEMATIC REFERENCE 430951.

1. CUT EMITTER LEADS OF Q15, Q16, Q17, Q18, Q19, Q6, Q5, AND Q20 OFF AT CASE

NOTES: UNLESS OTHERWISE SPECIFIED

403440	4800		
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	.004
XX .020	FORMED	.001
XXX .010	1°	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL | FINISH

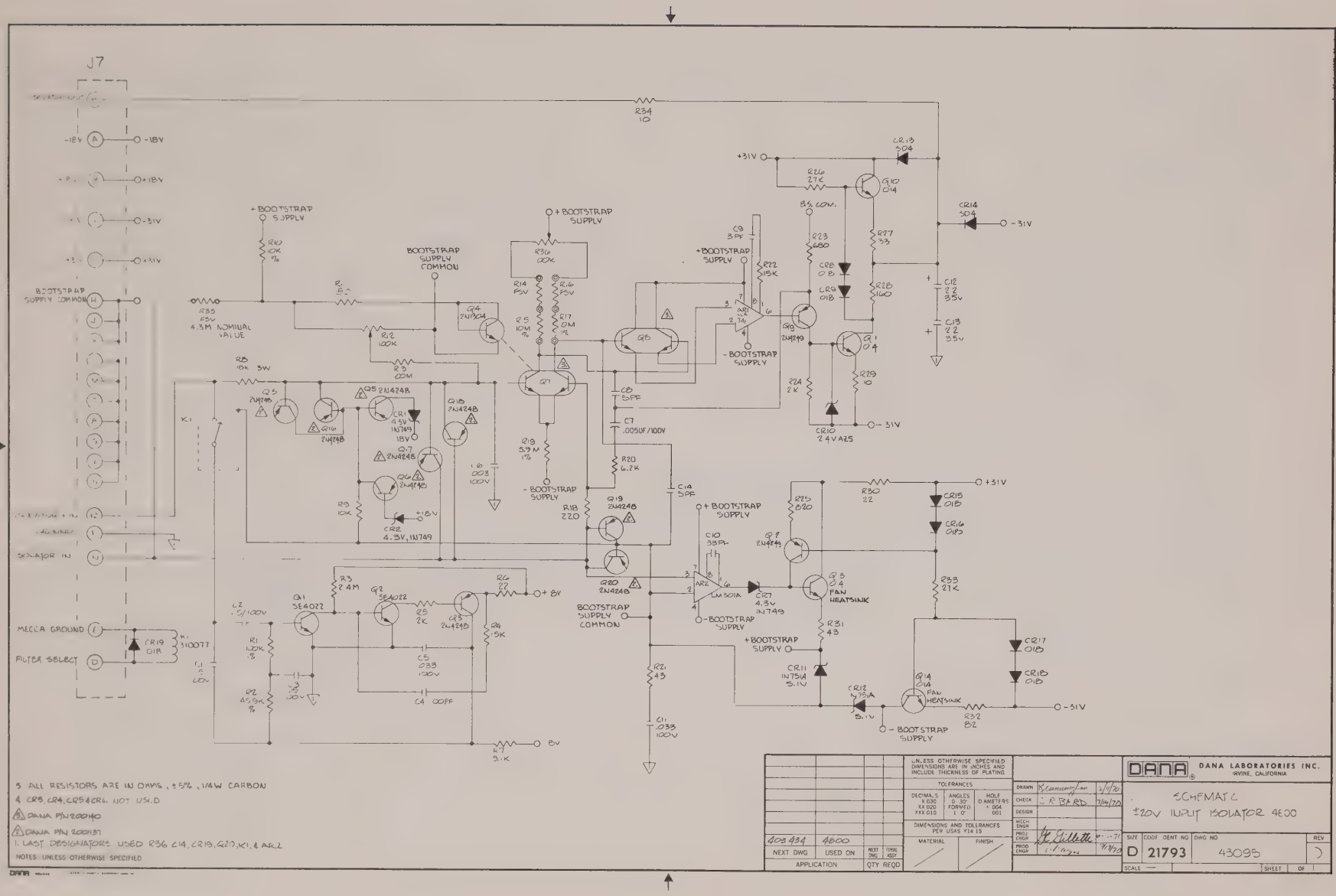
DRAWN	[illegible]	6/16/70
CHECK	R. BAIRD	6/17/70
DESIGN	[illegible]	6/19/70
MECH ENGR		
PROJ ENGR	G. Gillette	7/21/70
PROD ENGR	[illegible]	6/23/70

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSY PC BOARD ISOLATOR

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403434	.

SCALE 2:1 SHEET 1 OF 3



5 ALL RESISTORS ARE IN OHMS, ±5%, 1/4W CARBON

4 CR3, CR4, CR5 & CR6, NOT USED

⚠5 DANA P/N 200140

⚠4 DANA P/N 200137

1. LAST DESIGNATORS USED R36, C14, CR19, Q20, K1, & AR2

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0 30'	+ .004
XX .020	FORMED	- .001
XXX .010	1 0°	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL / FINISH

NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
403434	4800		
APPLICATION		QTY REQD	

DRAWN K. Cunningham 6/1/70

CHECK J. R. Bracken 7/14/70

DESIGN

MECH ENGR

PROJ ENGR H. Gillette 7-1-70

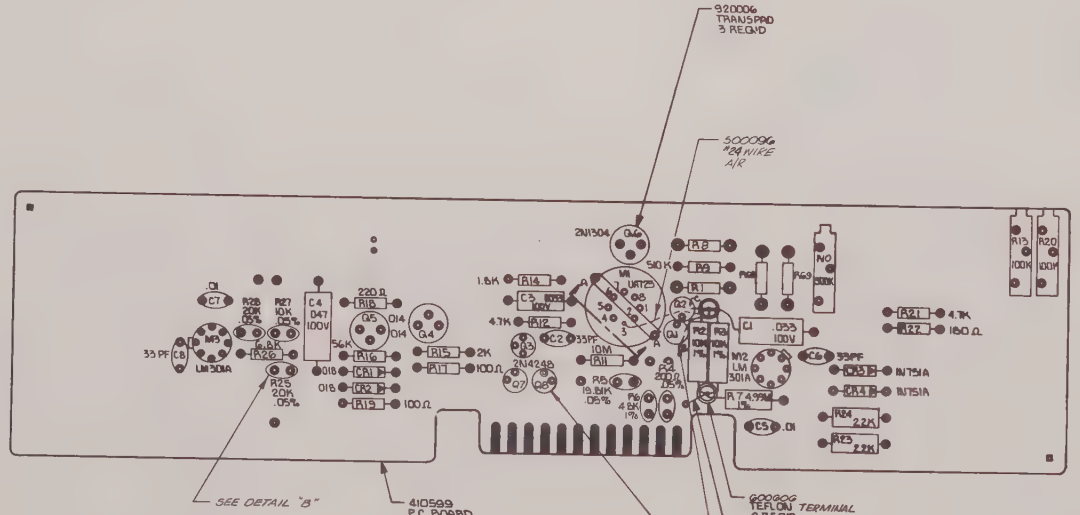
PROD ENGR 7/14/70

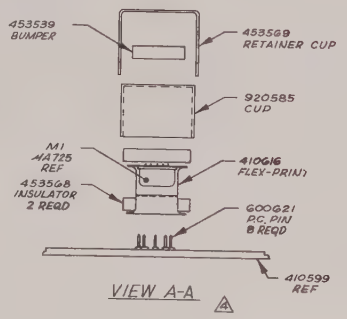
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC
±20V INPUT ISOLATOR 4E00

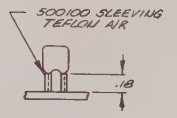
SIZE	CODE IDENT NO	DWG NO	REV
D	21793	43095	)

SCALE — SHEET OF





VIEW A-A



DETAIL B

MOUNT VISHAY RESISTORS R4, R5, R6, R25, R27, R29 ABOVE PC BOARD AS SHOWN

⚠ MINIMUM BEND RADIUS WHEN FORMING FLEXPRINT IS 0.03". AFTER SOLDERING TO PC B AND IC CIRCUIT SIDE OF FLEXPRINT IS TO BE SPRAYED WITH HUMISEAL.

3. SCHEMATIC REFERENCE - 430963
2. R1, R8, R68 & R69 ARE PART OF 403490 (725 OP AMP KIT)
1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

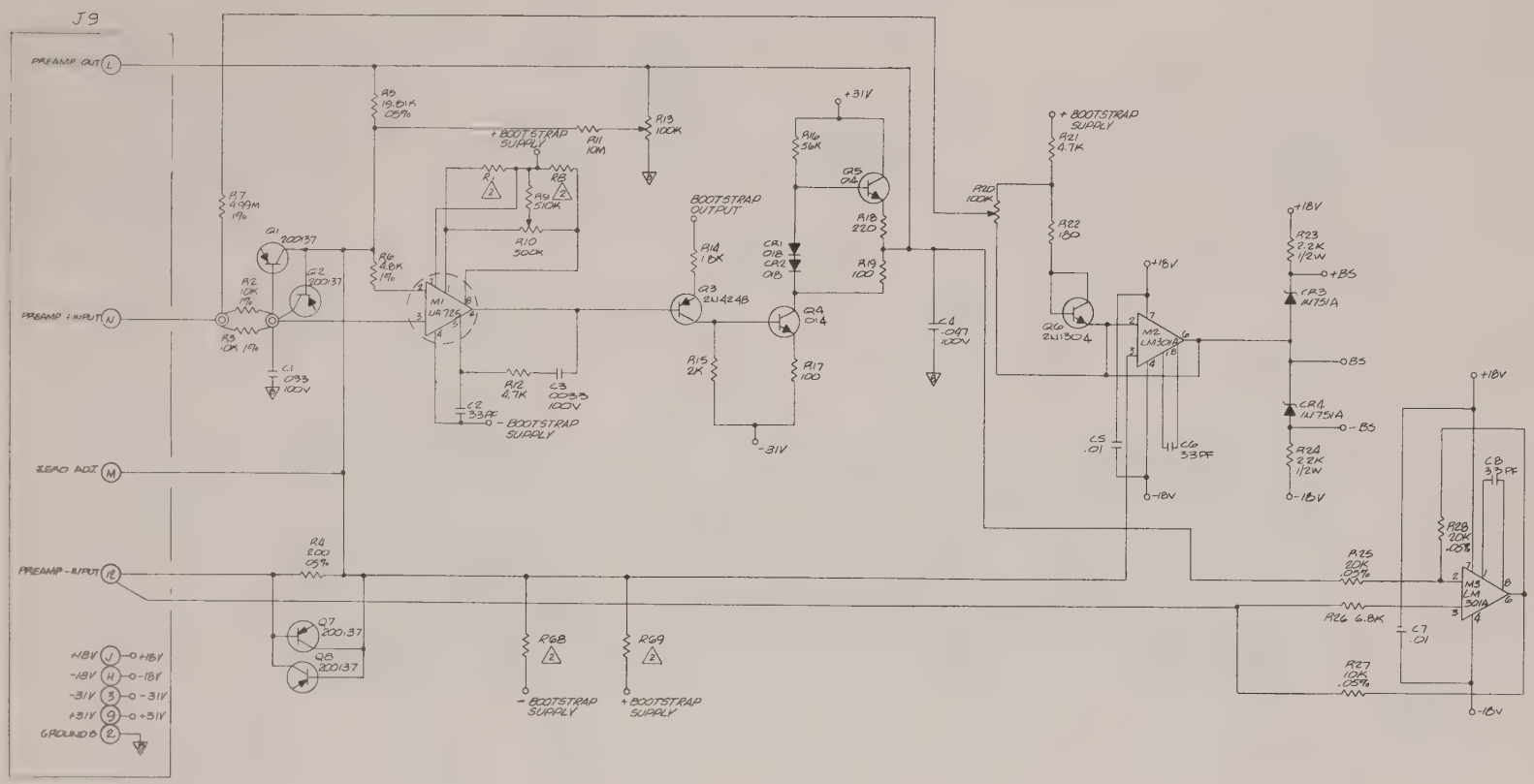
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY
MV CARD

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403464	B

SCALE 2:1 SHEET 1 OF 4

SHTS 2, 3, 4 ARE "A" SIZE



2 R1, R8, R69 & R68 ARE PART OF 403494 (725 OP AMP KIT)

1 LAST DESIGNATORS USED: A30, CR4, C8, Q8 & M3

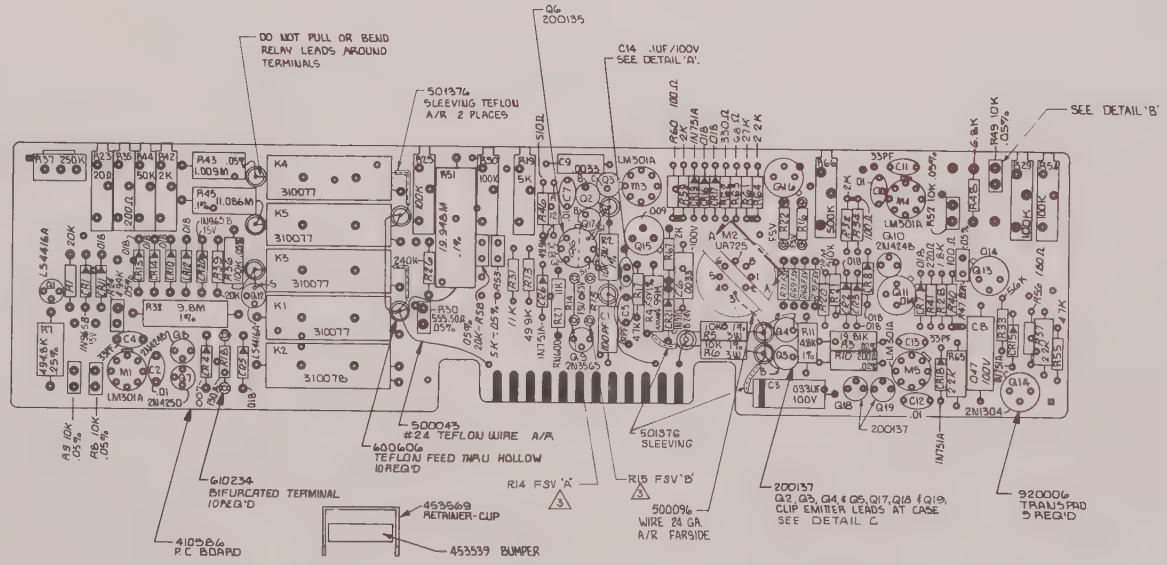
NOTES: UNLESS OTHERWISE SPECIFIED

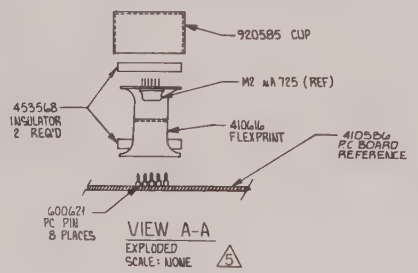
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

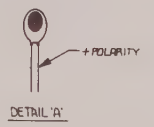
SCHEMATIC
MV CARD

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	430963	F

SCALE — SHEET / OF /


DO NOT PULL OR BEND RELAY LEADS AROUND TERMINALS
501376 SLEEVING TEFLON A/R 2 PLACES
Q6 200135
C14 .1UF/100V SEE DETAIL 'A'.
SEE DETAIL 'B'
DETAIL C
FOR Q2,3,4,5 & 17
500043 #24 TEFLON WIRE A/R
600604 TEFLON FEED THRU HOLLOW 10 REQ'D
610234 BIFURCATED TERMINAL 10 REQ'D
410586 P.C. BOARD
R14 FSV 'A' 3
R15 FSV 'B' 3
501376 SLEEVING
500096 WIRE 24 GA. A/R FARSIDE
200137 Q2, Q3, Q4 & Q5, Q17, Q18 & Q19. CLIP EMITTER LEADS AT CASE SEE DETAIL C
920006 TRANSPAD 5 REQ'D
453668 RETAINER-CUP
453539 BUMPER





DETAIL 'B'
MOUNT VISHAY RESISTORS R8, R9, R24, R30, R47, R49, R52, R53 & R58 ABOVE PC BOARD AS SHOWN.

3 MINIMUM BEND RADIUS WHEN FORMING FLEXPRINT IS 0.03". AFTER SOLDERING TO PCB AND I.C. CIRCUIT SIDE OF FLEXPRINT IS TO BE SPRAYED WITH HUMISEAL.

4 SCHEMATIC REFERENCE 430950.

5 IF THE FET, Q6, P/N 200135 IS MARKED 'A' THE 'FSV' RESISTOR IN THE KIT SHOULD BE INSTALLED AT R14 AND THE JUMPER AT R15. IF IT IS MARKED 'B' THE 'FSV' RESISTOR IS INSERTED AT R15 AND THE JUMPER AS R14.

2. _____

1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS.

NOTES: UNLESS OTHERWISE SPECIFIED.

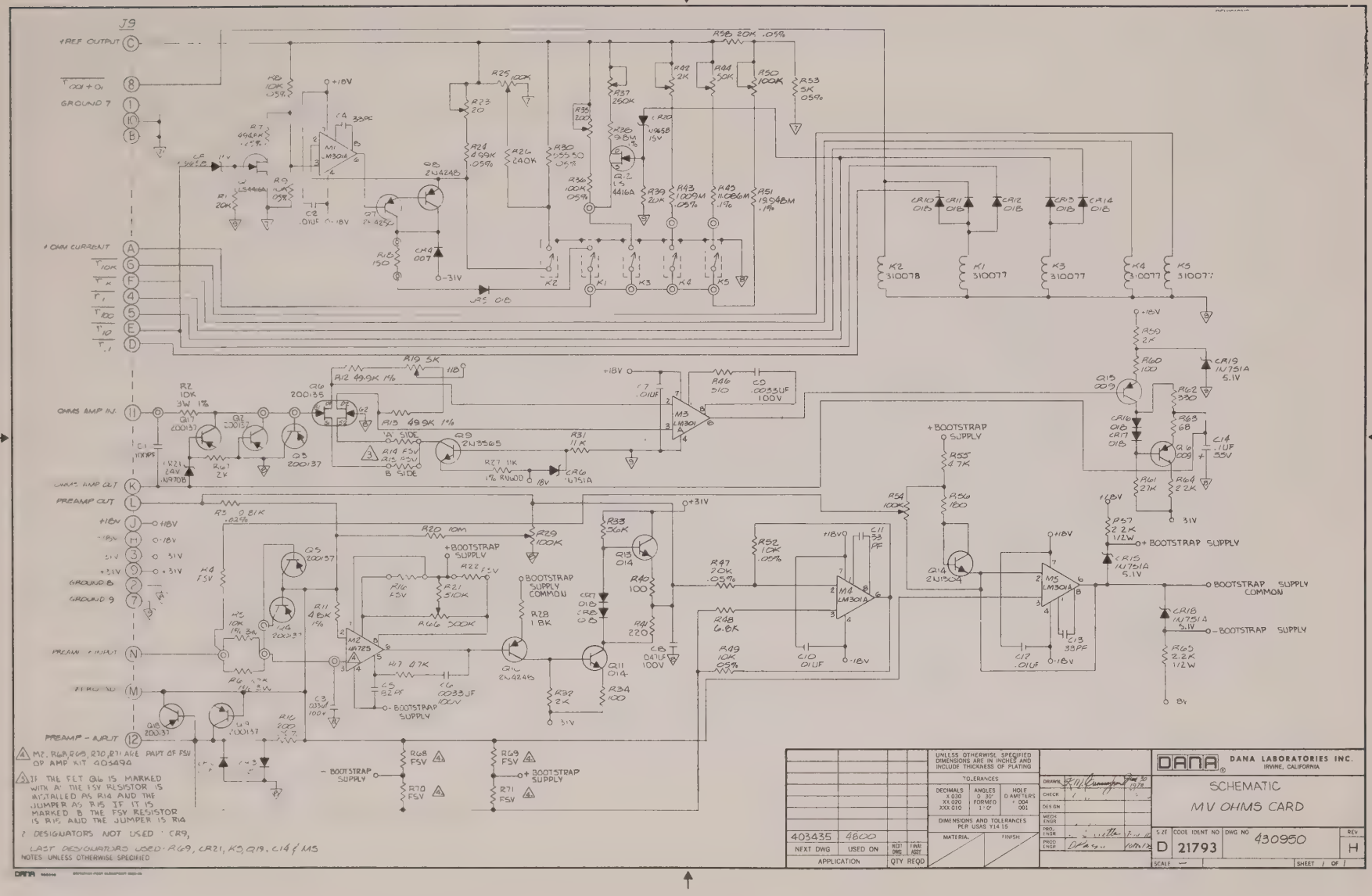
DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

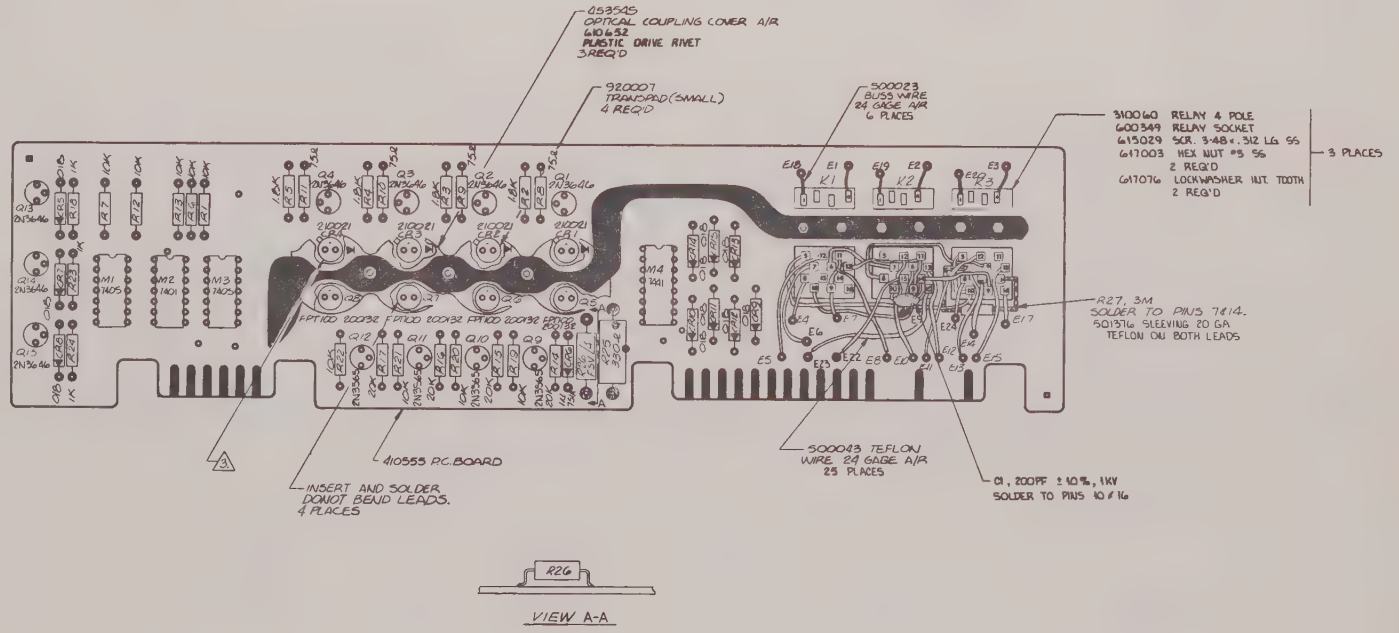
ASSEMBLY
MV OHMS
ACCESSORY

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	403435	

SCALE 2:1 SHEET 1 OF 2

SHEETS 2 THRU 6 ARE A SIZE


J9
+REF OUTPUT
GROUND 7
+OHM CURRENT
OHMS AMP IN
OHMS AMP OUT
PREAMP OUT
+18V
-18V
+31V
GROUNDS 8
GROUND 9
PREAMP + INPUT
PREAMP - INPUT
+BOOTSTRAP SUPPLY
-BOOTSTRAP SUPPLY
BOOTSTRAP SUPPLY COMMON
K1 310077
K2 310078
K3 310077
K4 310077
K5 310077
M1 LM301A
M2 LM725
M3 LM301
M4 LM301A
M5 LM301A
A SIDE
B SIDE
M2, R68, R69, R70, R71 ARE PART OF FSV OP AMP KIT 403490
IF THE FET Q6 IS MARKED WITH A' THE 1 5V RESISTOR IS INSTALLED AS R14 AND THE JUMPER AS R15 IF IT IS MARKED B THE 5V RESISTOR IS R15, AND THE JUMPER IS R14
? DESIGNATORS NOT USED · CR9,
LAST DESIGNATORS USED · R69, CR21, K5, Q19, C14 & M5
NOTES: UNLESS OTHERWISE SPECIFIED
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING
TOLERANCES
DECIMALS X.030 XX.020 XXX.010
ANGLES 0 30' FORMFO 1 0'
HOLE DIAMETERS +.004 -.001
DIMENSIONS AND TOLERANCES PER USAS Y14.15
MATERIAL
FINISH
403435
4800
NEXT DWG
USED ON
APPLICATION
QTY REQD
DANA
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC
MV OHMS CARD
SIZE D
CODE IDENT NO 21793
DWG NO 430950
REV H
SCALE —
SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED:

1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
2. SCHEMATIC REF. NO. 430952.
3. WHEN USING LED'S WITH 3 LEADS DISREGARD TAB ON CASE AND USE 3 HOLE PATTERN ON BOARD.

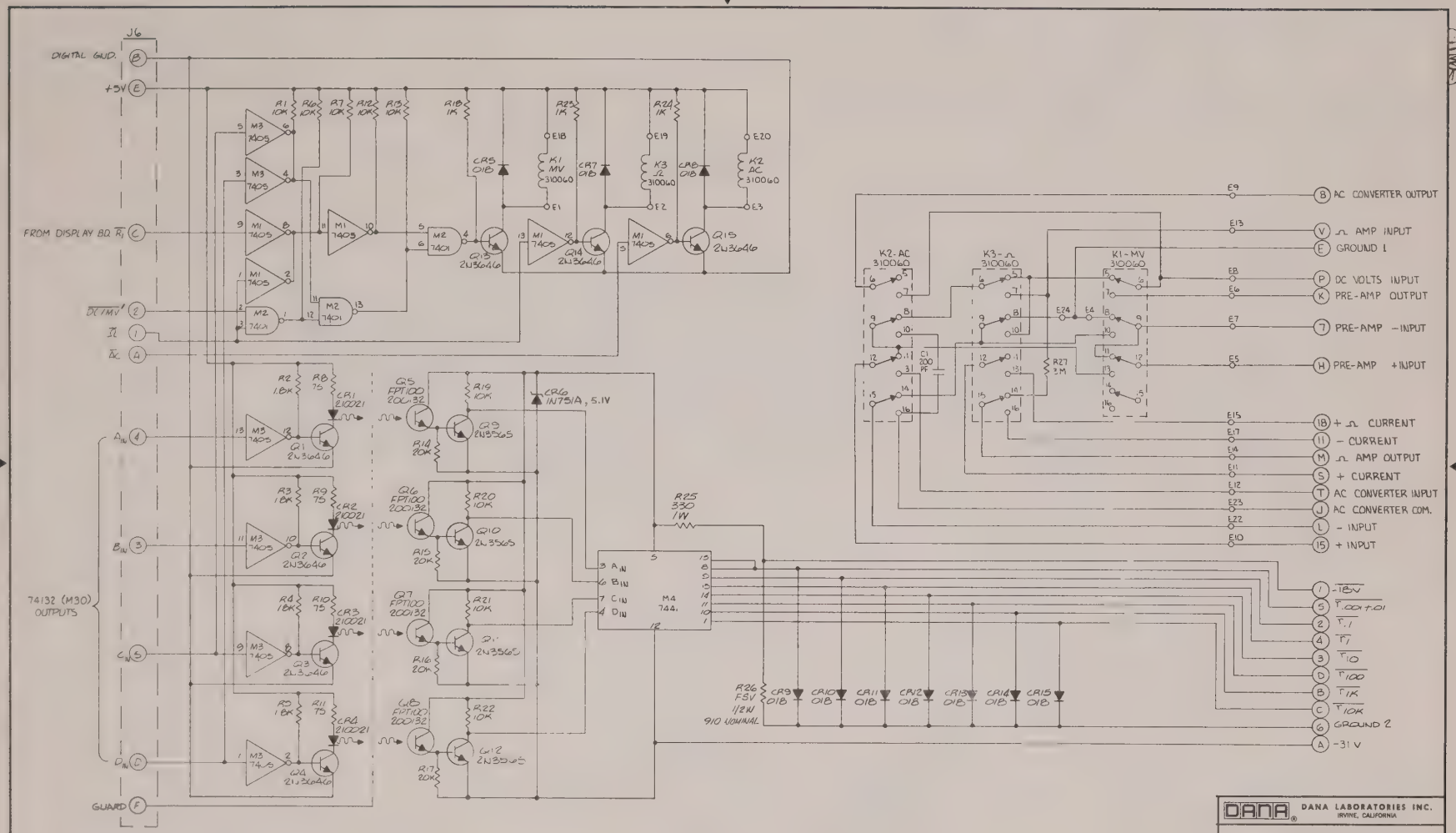
△2 INSTALL 910 Ω (P/N 001784) VZW1 DURING INITIAL ASSEMBLY

DANA LABORATORIES INC
IRVINE CALIFORNIA

ASSEMBLY
SWITCHING CARD

SIZE	COOF IDENT NO	DWG NO	REV
D	21793	403431	F

SCALE 2:1 SHEET 1 OF 3



2 ALL RESISTORS ARE 1Ω OHMS, 1/4W CARBON ±5%.
1 LAST DESIGNATORS USED: R27, CR15, Q15, K3 AND M4.
NOTES: UNLESS OTHERWISE SPECIFIED

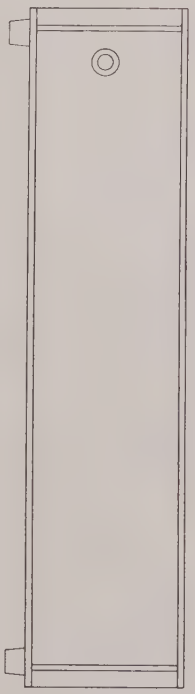
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

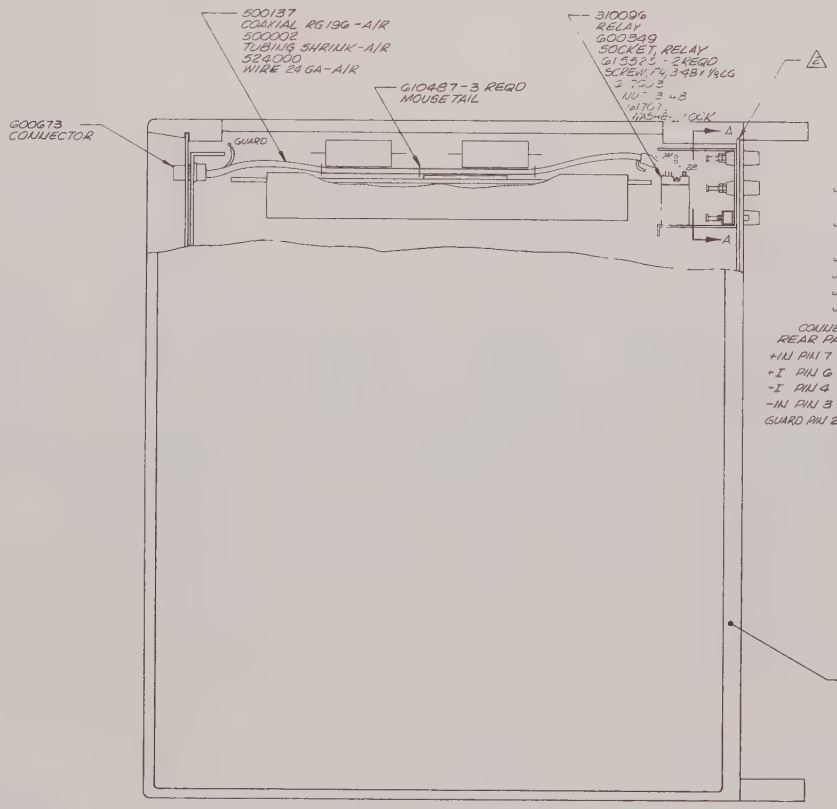
SCHEMATIC
SWITCHING CARD

SIZE	CODE IDENT NO.	DWG NO	REV
D	21793	430952	C

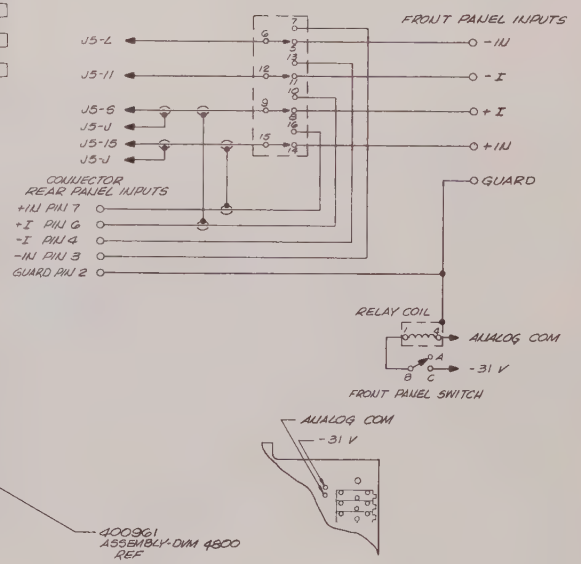
SCALE NONE | SHEET 1 OF 1

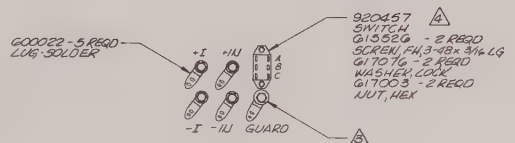
REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
A	RELEASED PER DRN # 995	1/4/71		





WIRING DIAGRAM





VIEW A-A

△2 USE LOCTITE 920056 ON SCREWS
△3 REPLACE WASHER G10639 WITH G10615
△4 REPLACE PANEL 453492 WITH 453624
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

4800			
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING

TOLERANCES

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	+ .004
XX .020	FORM(1)	- .001
XXX .010	1° 0'	

DIMENSIONS AND TOLERANCES PER USAS Y14.15

MATERIAL | FINISH

DRAWN		1/24/70
CHECK		1/29/70
DESIGN		2/4/70
MECH ENGR		
PROJ ENGR		3/23/70
PROD ENGR		4/24/70

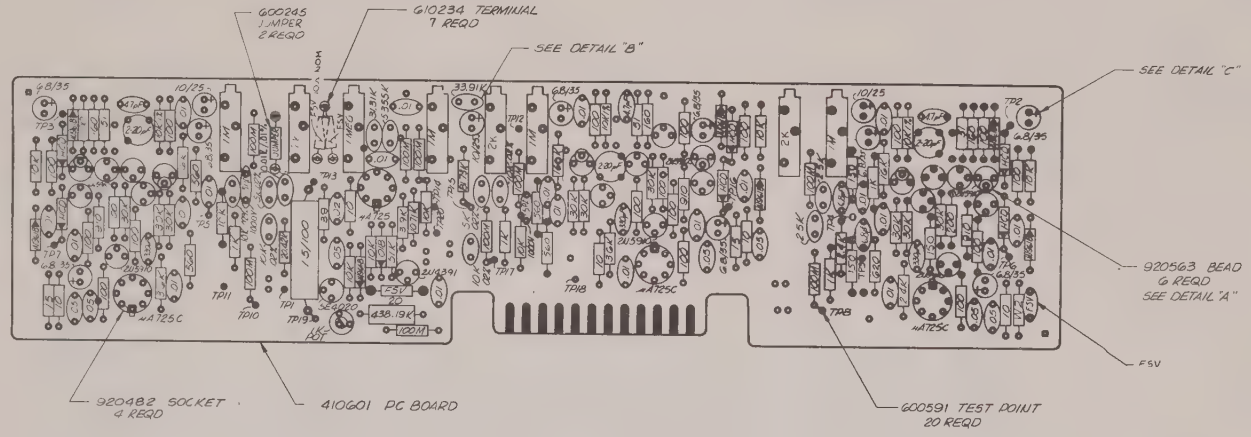
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ACCESSORY ASSY REAR INPUT-4800

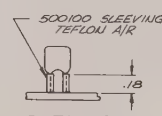
SIZE	CODE IDENT NO	DWG NO	REV
D	21793	403502	A

SCALE 1/2 1/4 | SHEET 1 OF 2

SHT 2 IS AN "A" SIZE



DETAIL A
6 PLACES



DETAIL B

MOUNT VISHAY RESISTORS R1, R2, R6, R7, R8, R61, R70, R72, R73 R78, R79, R82 ABOVE PC BOARD AS SHOWN

DETAIL C

4. HCD IS 210035 P/N
3. ALL TRANSISTORS THAT DO NOT HAVE A VALUE CALLED OUT ARE SE3005
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
1. REF SCHEMATIC 430964

NOTES : UNLESS OTHERWISE SPECIFIED

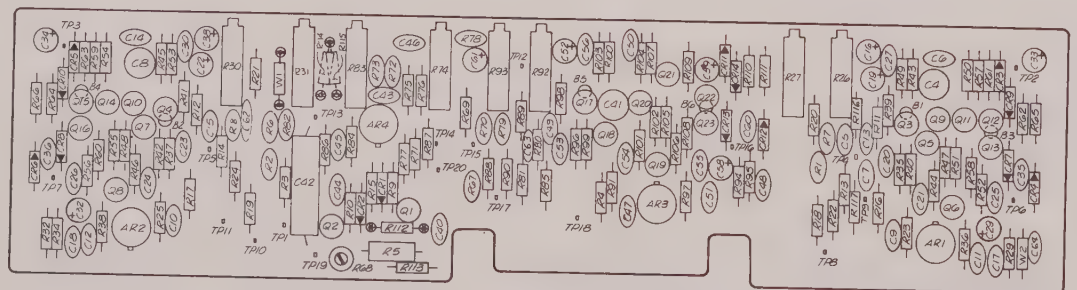
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

A C CONVERTER ASSEMBLY

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403470	F

SCALE 2:1 SHEET 1 OF 7

SHEETS 3 THRU 7 ARE A SMD P/L



2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
1. REF SCHEMATIC 430964

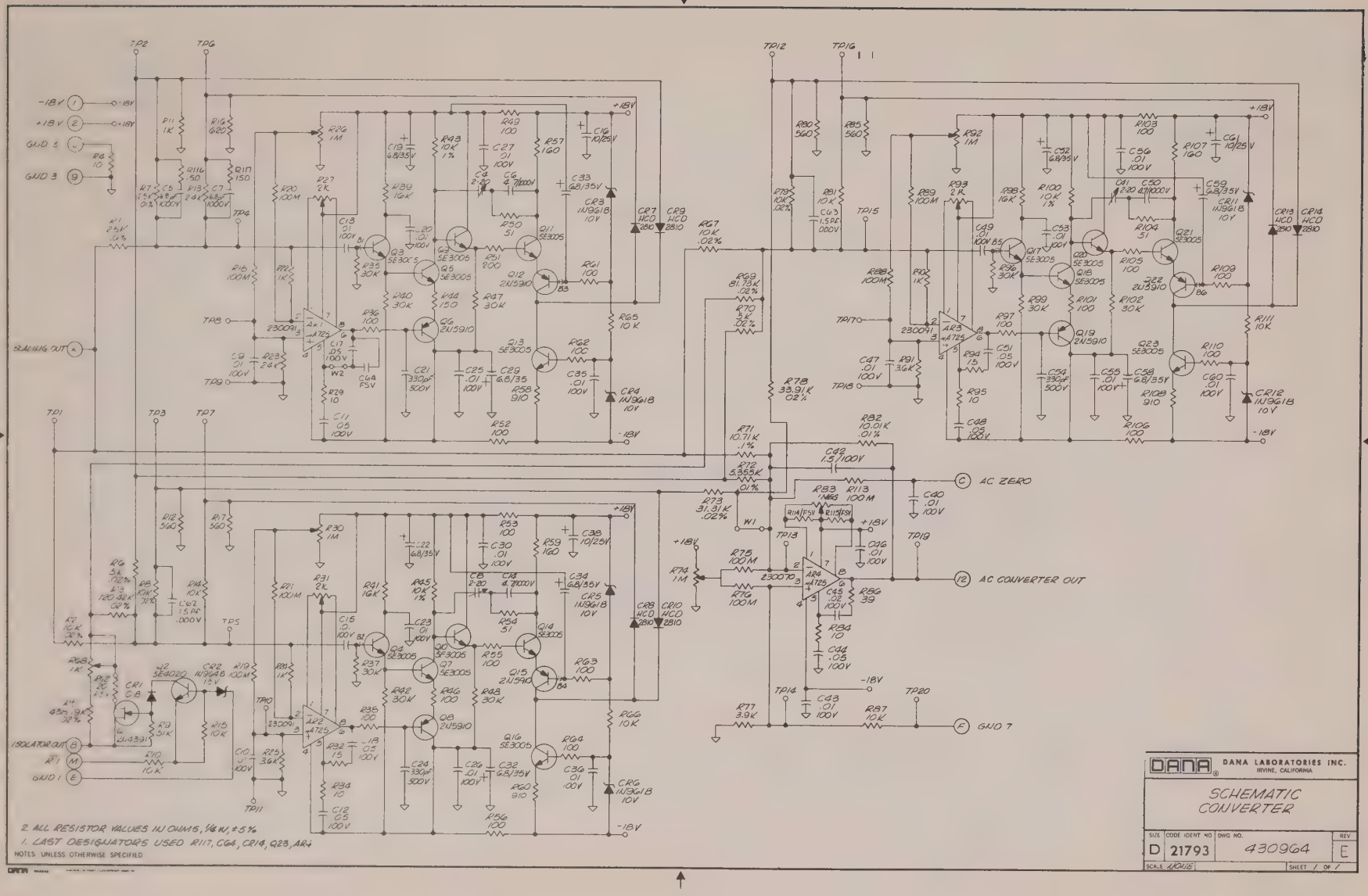
NOTES: UNLESS OTHERWISE SPECIFIED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

AC CONVERTER ASSEMBLY

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	403470	F

SCALE 2/1 SHEET 2 OF 7


-18V
+18V
GND 5
GND 3
SCALING OUT
RESOLATOR OUT
GND 1
AC ZERO
AC CONVERTER OUT
GND 7
+18V
-18V
2N3391
2N5910
2N5911
2N3019
2N3020
2N3906
2N3905
2N3904
2N3903
2N3638
2N3640
2N3641
2N3642
2N3643
2N3644
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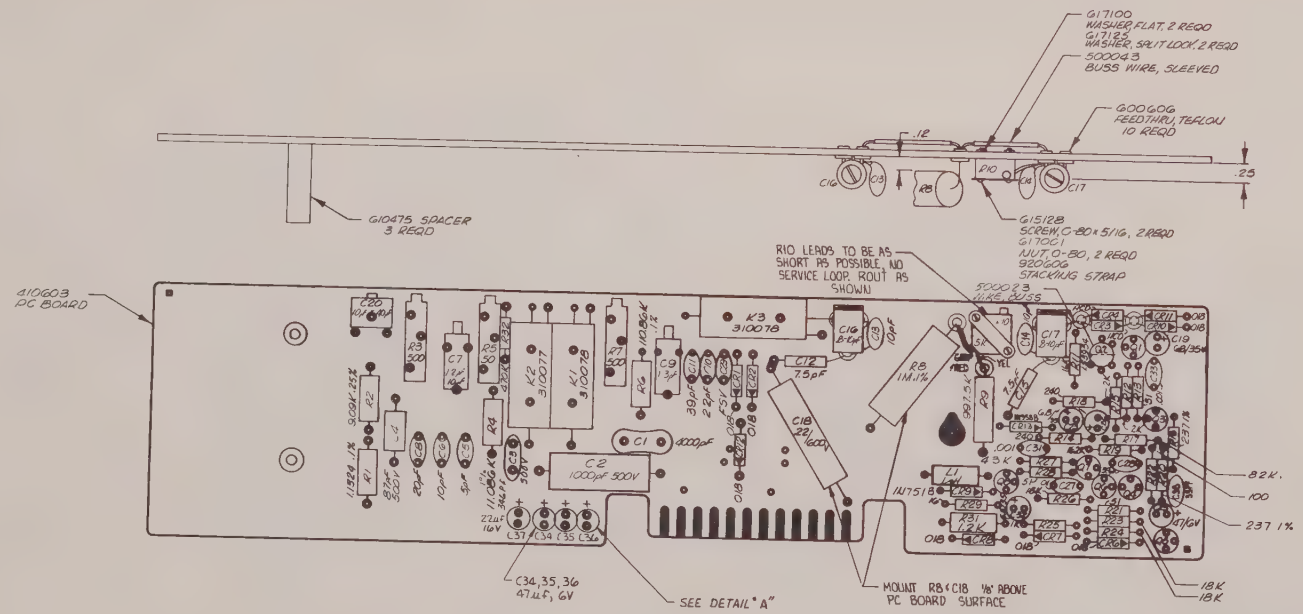
2N3679



4 HCO IS 210035 P/N
3. Q1,Q3,Q4,Q5,Q6,Q7 & Q8 ARE SE3005
2. SCHEMATIC REF "430964
1. ASSEMBLY PROCESSES & PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES : UNLESS OTHERWISE SPECIFIED

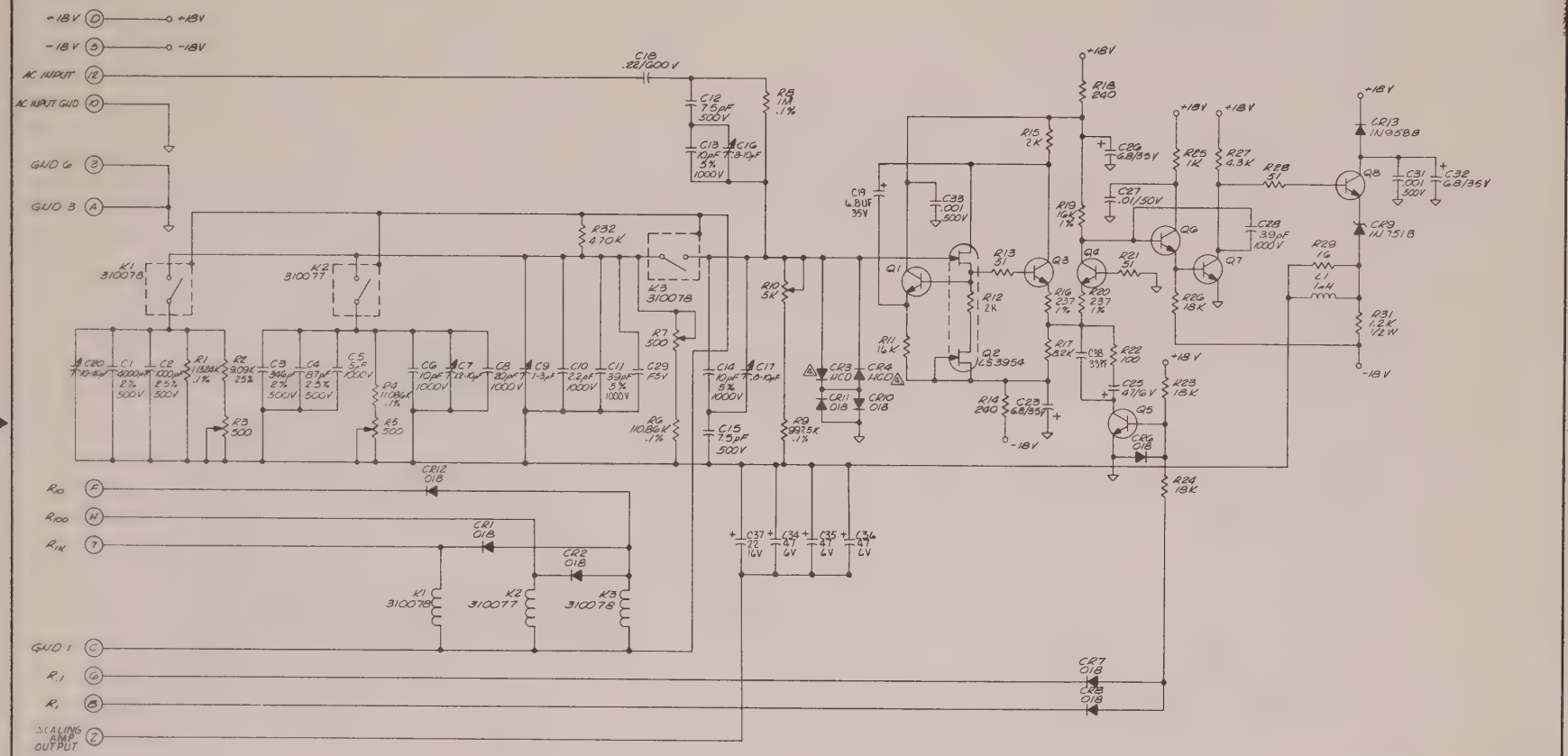
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCALING AMD ASSEMBLY

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403472	F

SCALE 2/1 SHEET 1 OF 3

SHEETS 2 THRU 5 ARE A SIZE

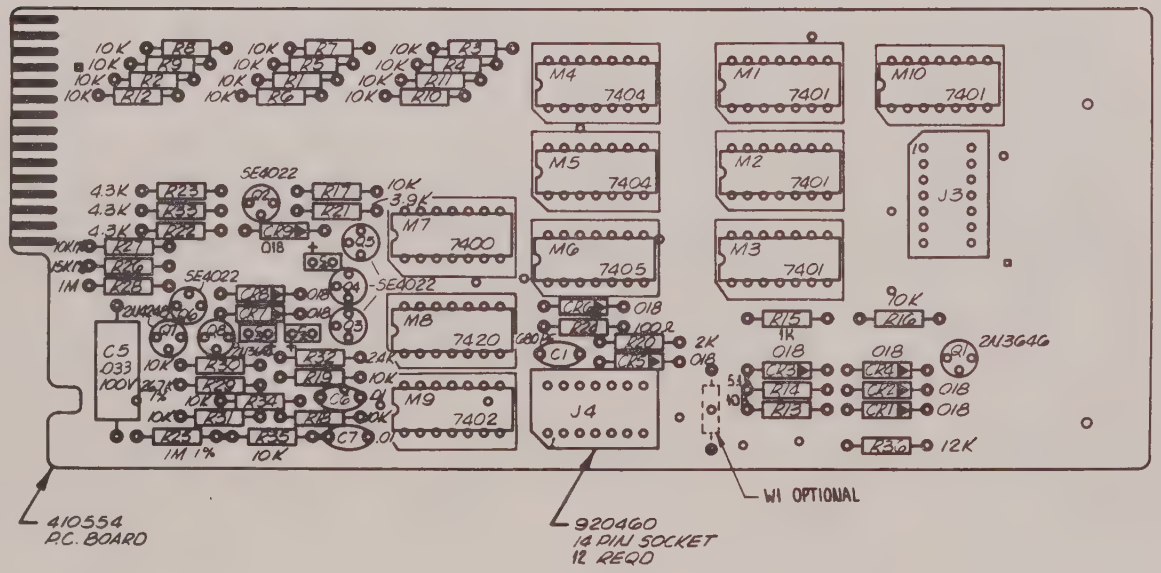


⚠ HCD IS AMI 210035
3. TRANSISTORS Q1, Q3, Q4, Q5, Q6, Q7 & Q8 ARE SE3005
2. ALL RESISTOR VALUE IN OHMS, 1/2 W, ± 5%
1. LAST DESIGNATORS USED R32, C38, CR13, Q8, K3
NOTES: UNLESS OTHERWISE SPECIFIED

DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC
SCALING AMP

SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	430966	D
SCALE NONE		SHEET 1 OF 1	



3. C2-.47/50V, C3-.22/50V, C4-.27/50V

2. SCHEMATIC REFERENCE 430959

1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

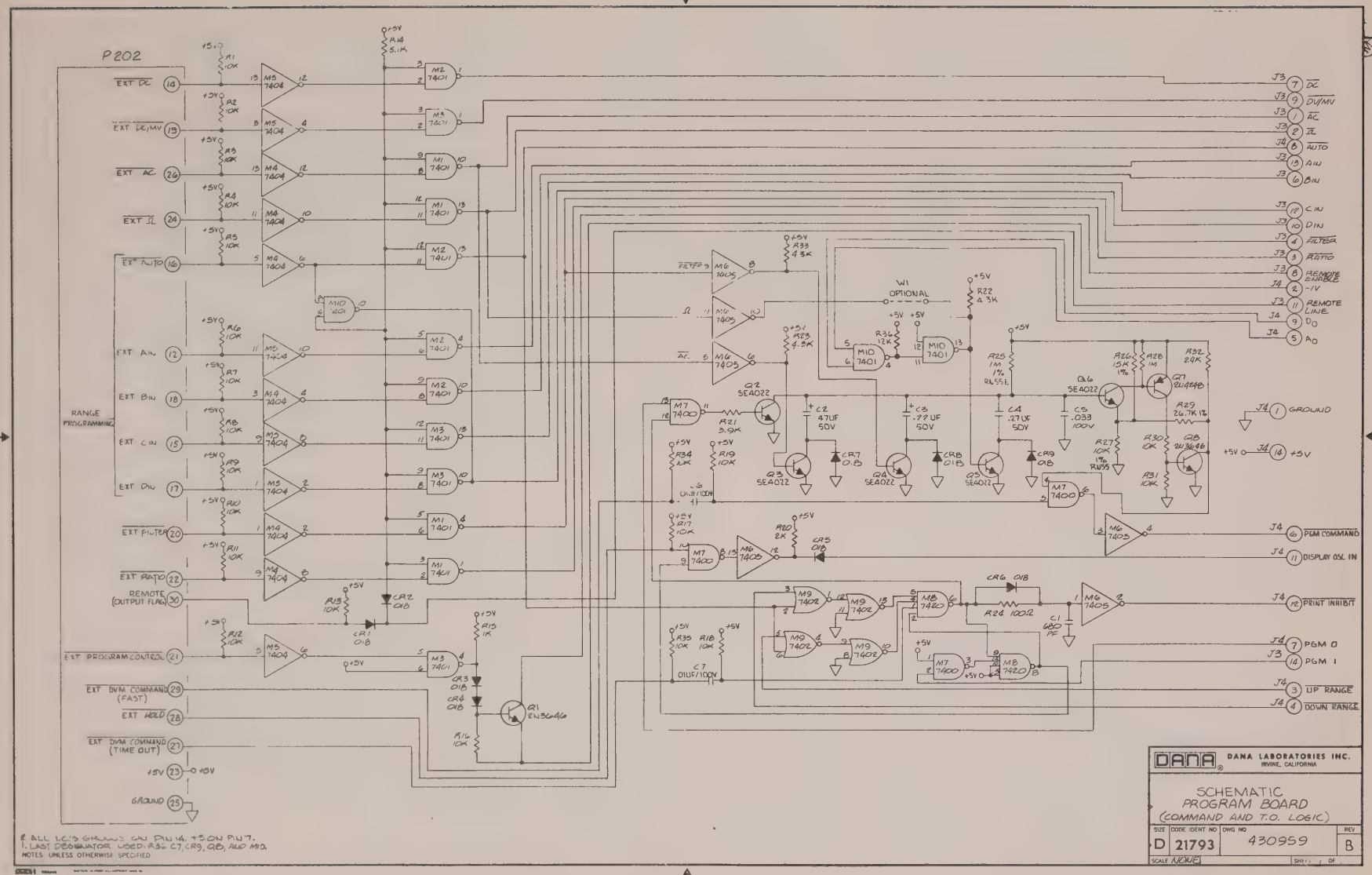
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY PROGRAMMING BOARD

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	403436	D

SCALE 2:1 SHEET 1 OF 3

Dims in Inches A size



DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC
PROGRAM BOARD
(COMMAND AND T.O. LOGIC)

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	430959	B

SCALE NONE SHEET 1 OF

PARTS LIST

ASSEMBLY 403433 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION			
CR01	211083	DIODE SILICO	018	DANA	211083
CR02	211083	DIODE SILICO	018	DANA	211083
CR03	211083	DIODE SILICO	018	DANA	211083
CR04	210021	DIODE		DANA	210021
CR04	920007	TRANSISTOR PAD		M-R	10045
CR05	210021	DIODE		DANA	210021
CR05	920007	TRANSISTOR PAD		M-R	10045
CR06	211083	DIODE SILICO	018	DANA	211083
CR07	211083	DIODE SILICO	018	DANA	211083
CR08	211083	DIODE SILICO	018	DANA	211083
CR09	211083	DIODE SILICO	018	DANA	211083
CR10	211083	DIODE SILICO	018	DANA	211083
CR11	211083	DIODE SILICO	018	DANA	211083
CR12	211083	DIODE SILICO	018	DANA	211083
CR13	211083	DIODE SILICO	018	DANA	211083
CR14	211083	DIODE SILICO	018	DANA	211083
CR15	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR16	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR17	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR18	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR19	220015	DIODE SILICO ZENER	1N967B	MOTOROLA	1N967B
CR20	211083	DIODE SILICO	018	DANA	211083
CR21	211083	DIODE SILICO	018	DANA	211083
CR22	220015	DIODE SILICO ZENER	1N967B	MOTOROLA	1N967B
CR23	211083	DIODE SILICO	018	DANA	211083
CR24	220007	DIODE SILICO ZENER	1N751	MOTOROLA	1N751
CR25	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR26	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR27	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR28	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR29	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR30	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR31	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR32	220007	DIODE SILICO ZENER	1N751	MOTOROLA	1N751
CR33	211083	DIODE SILICO	018	DANA	211083

PARTS LIST

ASSEMBLY 403433 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION				
CR34	220040	DIODE ZENER				SEMCOR 1N753
CR35	211083	DIODE SILICO	018			DANA 211083
C01	101145	CAP CERAM	100 PFD	500 V	10%	AERCVOX SCD1X5F
C02	101099	CAP CERAM	680 PFD	500 V	10%	AERCVCX SCD2X5F
C03	110071	CAP ELECT	.1 MFD	35 V	10%	KEMET K1W35K
C04	110129	CAP TANTA	.1MF	35V		ITT 4321217010
C05	110129	CAP TANTA	.1MF	35V		ITT 4321217010
C06	110067	CAP ELECT	2000 MFD	35 V	20%	DUCATI 2000-35
C07	110067	CAP ELECT	2000 MFD	35 V	20%	DUCATI 2000-35
C08	110036	CAP ELECT	25 MFD	50 V	20%	DUCATI 25-50
C09	110036	CAP ELECT	25 MFD	50 V	20%	DUCATI 25-50
C10	110036	CAP ELECT	25 MFD	50 V	20%	DUCATI 25-50
C11	110036	CAP ELECT	25 MFD	50 V	20%	DUCATI 25-50
C18	110069	CAP ELEC	10 MFD	10 V		KEMET K10W10K
C19	110127	CAP TANT	22 MFD	6.3 V		ITT 43212 12222
C20	101642	CAP CERAM	150 PFD	500 V	10%	AERCVOX SCD2X5F
C21	100012	CAP CERAM	33 PFD	500 V	10%	AERCVOX TCD-N750
C22	100008	CAP CERAM	82 PFD	500 V	10%	AERCVOX TCD-N750
C23	110128	CAP	6000 MFD	10 V		SPRGUE36D602G010AA2A
C24	110127	CAP TANT	22 MFD	6.3 V		ITT 43212 12222
C25	110127	CAP TANT	22 MFD	6.3 V		ITT 43212 12222
J01	453505	CONN 12 P				CINCH 252-12-30-160
J02	600280	CONN 12 P				CINCH 252-12-30-
J03	920460	INTEGRATED CIRCUIT				AUGAT 314AG5D-2R
J04	920460	INTEGRATED CIRCUIT				AUGAT 314AG5D-2R
J05	600228	CONN 18 P				CINCH 252-18-30-160
J06	600671	CONN				CINCH 50-12B-10
J07	600280	CONN 12 P				CINCH 252-12-30-
J08	600670	CONN 10 P				CINCH 50-20B-10
J09	600280	CONN 12 P				CINCH 252-12-30-
J11	600280	CONN 12 P				CINCH 252-12-30-
J12	600280	CONN 12 P				CINCH 252-12-30-
K01	310063	RELAY	150 OHM			P & B R10E1221-1
K02	310063	RELAY	150 OHM			P & B R10E1221-1

PARTS LIST

ASSEMBLY 403433 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION			
K03	310063	RELAY	150 OHM	P & B	R10E1221-1
K04	310076	RELAY	28 V	P & B	R10E-1297-2
L01	310062	CHOKE	22 UH	DELEVAN	1537-44
M01	230034	INTEGRATED CIRCUIT		TI	SN7441N
M01	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT	316AG5D-2R
M02	230034	INTEGRATED CIRCUIT		TI	SN7441N
M03	230034	INTEGRATED CIRCUIT		TI	SN7441N
M04	230034	INTEGRATED CIRCUIT		TI	SN7441N
M04	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT	316AG5D-2R
M05	230038	INTEGRATED CIRCUIT		TI	SN74H11N
M05	920460	INTEGRATED CIRCUIT		AUGAT	314AG5D-2R
M06	230028	INTEGRATED CIRCUIT		TI	SN7400N
M06	920460	INTEGRATED CIRCUIT		AUGAT	314AG5D-2R
M07	230065	INTEGRATED CIRCUIT		TI	SN7475N
M07	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT	316AG5D-2R
M08	230065	INTEGRATED CIRCUIT		TI	SN7475N
M09	230065	INTEGRATED CIRCUIT		TI	SN7475N
M10	230065	INTEGRATED CIRCUIT		TI	SN7475N
M10	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT	316AG5D-2R
M11	230030	INTEGRATED CIRCUIT		TI	SN7402N
M11	920460	INTEGRATED CIRCUIT		AUGAT	314AG5D-2R
M12	230035	INTEGRATED CIRCUIT		TI	SN7473N
M13	230037	INTEGRATED CIRCUIT		TI	SN7490N
M14	230037	INTEGRATED CIRCUIT		TI	SN7490N
M15	230037	INTEGRATED CIRCUIT		TI	SN7490N
M16	230037	INTEGRATED CIRCUIT		TI	SN7490N
M17	230028	INTEGRATED CIRCUIT		TI	SN7400N
M18	230030	INTEGRATED CIRCUIT		TI	SN7402N
M19	230072	INTEGRATED CIRCUIT		TI	SN7474N
M20	230035	INTEGRATED CIRCUIT		TI	SN7473N
M21	230028	INTEGRATED CIRCUIT		TI	SN7400N
M22	230063	INTEGRATED CIRCUIT		TI	SN7440N
M23	230029	INTEGRATED CIRCUIT		TI	SN7401N
M24	230064	INTEGRATED CIRCUIT		TI	SN7404N
M25	230030	INTEGRATED CIRCUIT		TI	SN7402N

PARTS LIST

ASSEMBLY 403433 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION		
M26	230072	INTEGRATED CIRCUIT		TI SN7474N
M27	230031	INTEGRATED CIRCUIT		TI SN7410N
M28	230064	INTEGRATED CIRCUIT		TI SN7404N
M28	920460	INTEGRATED CIRCUIT		AUGAT 314AG5D-2R
M29	230036	INTEGRATED CIRCUIT		TI SN7483N
M29	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT 316AG5D-2R
M30	230067	INTEGRATED CIRCUIT		TI SN74192
M31	230036	INTEGRATED CIRCUIT		TI SN7483N
M31	920419	INTEGRATED CIRCUIT	SOCKET - 16 PIN	AUGAT 316AG5D-2R
M32	230028	INTEGRATED CIRCUIT		TI SN7400N
M32	920460	INTEGRATED CIRCUIT		AUGAT 314AG5D-2R
Q01	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q02	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q03	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q04	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q05	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q06	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q07	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q08	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q09	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q10	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q11	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q12	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q13	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q14	200129	TRANS		FAIRCHILD SE4020
Q15	200132	TRANS		FAIRCHILD FPT100
Q16	200132	TRANS		FAIRCHILD FPT100
Q17	200129	TRANS		FAIRCHILD SE4020
Q18	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q19	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q20	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q21	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q22	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q23	200154	TRANS		MOTOROLA MJE370
Q24	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248

PARTS LIST

ASSEMBLY 403433 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
Q25	200155	TRANS						MOTOROLA	MJE520
Q26	200075	TRANS			2N4870			MOTOROLA	2N4870
Q27	200037	TRANS	SILICO	NPN	2N3646			FAIRCHILD	2N3646
Q28	200037	TRANS	SILICO	NPN	2N3646			FAIRCHILD	2N3646
Q29	200088	TRANS	SILICO	PNP	2N4248			FAIRCHILD	2N4248
Q30	200043	TRANS	SILICO	NPN	2N3565			FAIRCHILD	2N3565
Q31	200052	TRANS	SILICO	PNP	009			DANA	200052
R01	001681	RES	CARBON	7.5 K		5%	1/2 W	CHMITE	RC20GF752J
R02	001681	RES	CARBON	7.5 K		5%	1/2 W	CHMITE	RC20GF752J
R03	000750	RES	CARBON	75 OHM		5%	1/4 W	CHMITE	RC07GF750J
R04	000750	RES	CARBON	75 OHM		5%	1/4 W	CHMITE	RC07GF750J
R05	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R06	001681	RES	CARBON	7.5 K		5%	1/2 W	CHMITE	RC20GF752J
R07	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R08	000432	RES	CARBON	4.3 K		5%	1/4 W	CHMITE	RC07GF432J
R09	001681	RES	CARBON	7.5 K		5%	1/2 W	CHMITE	RC20GF752J
R10	000512	RES	CARBON	5.1 K		5%	1/4 W	CHMITE	RC07GF512J
R11	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R12	001681	RES	CARBON	7.5 K		5%	1/2 W	CHMITE	RC20GF752J
R13	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R14	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R15	000102	RES	CARBON	1 K		5%	1/4 W	CHMITE	RC07GF102J
R16	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R17	000432	RES	CARBON	4.3 K		5%	1/4 W	CHMITE	RC07GF432J
R18	000822	RES	CARBON	8.2 K		5%	1/4 W	CHMITE	RC07GF822J
R19	000512	RES	CARBON	5.1 K		5%	1/4 W	CHMITE	RC07GF512J
R20	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R21	000201	RES	CARBON	200 OHM		5%	1/4 W	CHMITE	RC07GF201J
R22	000201	RES	CARBON	200 OHM		5%	1/4 W	CHMITE	RC07GF201J
R23	000101	RES	CARBON	100 OHM		5%	1/4 W	CHMITE	RC07GF101J
R24	000102	RES	CARBON	1 K		5%	1/4 W	CHMITE	RC07GF102J
R25	000102	RES	CARBON	1 K		5%	1/4 W	CHMITE	RC07GF102J
R26	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J
R27	000200	RES	CARBON	20 OHM		5%	1/4 W	OHMITE	RC07GF200J
R28	000103	RES	CARBON	10 K		5%	1/4 W	CHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403433 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION						
R29	000200	RES	CARBON	20	OHM	5%	1/4 W	OHMITE RC07GF200J
R30	030015	RES	WW	100	K	1%	10 W	C-F M-100
R31	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE RC07GF203J
R32	010334	RES		SET				DANA 010334
R33	040187	POT	CERMET	500	OHM	20%		CTS 360T501B
R34	010334	RES		SET				DANA 010334
R35	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE RC07GF203J
R36	000182	RES	CARBON	1.8	K	5%	1/4 W	OHMITE RC07GF182J
R37	040187	POT	CERMET	500	OHM	20%		CTS 360T501B
R38	010607	RES	METAL	17.999	K	.05%		VISHAY V53-1
R39	001721	RES	CARBON	2.2	OHM	5%	1/2 W	OHMITE RC20GF020J
R40	010608	RES	METAL	1798.9	OHM	.05%		VISHAY V53-1
R41	010658	RES		199.8	OHM	.05%		VISHAY V53-1
R42	000106	RES	CARBON	10	M	5%	1/4 W	OHMITE RC07GF106J
R43	000106	RES	CARBON	10	M	5%	1/4 W	OHMITE RC07GF106J
R44	040113	RES	VARI	100	K	10%		BECKMAN 79P100K
R45	010645	RES	METAL			1%	T-0	IRC RN55D2371F
R46	000516	RES	CARBON	51	M	5%	1/4 W	OHMITE RC07GF516J
R47	040113	RES	VARI	100	K	10%		BECKMAN 79P100K
R48	000332	RES	CARBON	3.3	K	5%	1/4 W	OHMITE RC07GF332J
R49	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE RC07GF103J
R50	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE RC07GF512J
R51	000122	RES	CARBON	1.2	K	5%	1/4 W	OHMITE RC07GF122J
R52	000122	RES	CARBON	1.2	K	5%	1/4 W	OHMITE RC07GF122J
R53	000183	RES	CARBON	18	K	5%	1/4 W	OHMITE RC07GF183J
R54	001738	RES	CARBON	1.5	OHM	5%	1/2 W	OHMITE RC20GF010J
R55	001738	RES	CARBON	1.5	OHM	5%	1/2 W	OHMITE RC20GF010J
R56	001737	RES	FSV			5%	1/4 W	DANA 001737
R57	000151	RES	CARBON	150	OHM	5%	1/4 W	OHMITE RC07GF151J
R58	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE RC07GF102J
R59	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE RC07GF102J
R60	000391	RES	CARBON	390	OHM	5%	1/4 W	OHMITE RC07GF391J
R61	000121	RES	CARBON	120	OHM	5%	1/4 W	OHMITE RC07GF121J
R62	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE RC07GF102J
R63	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE RC07GF102J

PARTS LIST

ASSEMBLY 403433 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R64	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R65	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R66	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R67	020576	RES	WW	.24	OHM		5% 2W		
R68	040188	POT	CERMET	100	K	20%		CTS	360T104B
R69	010645	RES	METAL			1%	T-0	IRC	RN55D2371F
R70	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R71	040113	RES	VARI	100	K	10%		BECKMAN	79P100K
S01	600684	SWITCH PUSHBUTTON						DANA	600684
S02	600684	SWITCH PUSHBUTTON						DANA	600684
S03	600682	SWITCH PUSHBUTTON						DANA	600682
S04	600682	SWITCH PUSHBUTTON						DANA	600682
S05	600683	SWITCH PUSHBUTTON						DANA	600683
S06	600683	SWITCH PUSHBUTTON						DANA	600683
TP01	600591	POST, TEST POINT						AMP	85931-6
TP07	600591	POST, TEST POINT						AMP	85931-6
T01	403553	TRANSFORMER, PULSE						DANA	403553
T02	403553	TRANSFORMER, PULSE						DANA	403553
T03	403553	TRANSFORMER, PULSE						DANA	403553
V01	920466	TUBE, READOUT						AMPEREX	ZM1005
V02	920466	TUBE, READOUT						AMPEREX	ZM1005
V03	920466	TUBE, READOUT						AMPEREX	ZM1005
V04	920466	TUBE, READOUT						AMPEREX	ZM1005
V05	920466	TUBE, READOUT						AMPEREX	ZM1005
W01	600245	JUMPER						GETTIG	L-2007-1
Y01	920513	CRYSTAL			2.4 MHz			ERC	
R72	001737	RES	FSV				5% 1/4W	DANA	001737

PARTS LIST

ASSEMBLY 403430 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION			
CR01	211083	DIODE SILICO	018	DANA	211083
CR02	211083	DIODE SILICO	018	DANA	211083
CR03	211083	DIODE SILICO	018	DANA	211083
CR04	211083	DIODE SILICO	018	DANA	211083
CR05	211083	DIODE SILICO	018	DANA	211083
CR06	211083	DIODE SILICO	018	DANA	211083
CR07	211083	DIODE SILICO	018	DANA	211083
CR08	211083	DIODE SILICO	018	DANA	211083
CR09	211083	DIODE SILICO	018	DANA	211083
CR10	211083	DIODE SILICO	018	DANA	211083
CR11	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR12	211083	DIODE SILICO	018	DANA	211083
CR13	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR14	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR15	210004	DIODE SILICO	SD4	DIODES IN SD4	
CR16	211083	DIODE SILICO	018	DANA	211083
CR17	211083	DIODE SILICO	018	DANA	211083
CR18	211083	DIODE SILICO	018	DANA	211083
CR19	211083	DIODE SILICO	018	DANA	211083
CR20	220059	DIODE ZENER			
CR22	211083	DIODE SILICO	018	DANA	211083
CR23	211083	DIODE SILICO	018	DANA	211083
CR24	211083	DIODE SILICO	018	DANA	211083
CR25	211083	DIODE SILICO	018	DANA	211083
CR26	211083	DIODE SILICO	018	DANA	211083
CR27	211083	DIODE SILICO	018	DANA	211083
CR28	211083	DIODE SILICO	018	DANA	211083
CR29	211083	DIODE SILICO	018	DANA	211083
CR30	211083	DIODE SILICO	018	DANA	211083
CR31	211083	DIODE SILICO	018	DANA	211083
CR32	211083	DIODE SILICO	018	DANA	211083
CR33	211083	DIODE SILICO	018	DANA	211083
CR34	211083	DIODE SILICO	018	DANA	211083
CR35	211083	DIODE SILICO	018	DANA	211083
CR36	211083	DIODE SILICO	018	DANA	211083

PARTS LIST

ASSEMBLY 403430 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION			
CR37	211083	DIODE SILICO	018	DANA	211083
CR38	211083	DIODE SILICO	018	DANA	211083
CR39	211083	DIODE SILICO	018	DANA	211083
CR40	211083	DIODE SILICO	018	DANA	211083
CR41	211083	DIODE SILICO	018	DANA	211083
CR42	211083	DIODE SILICO	018	DANA	211083
CR43	211083	DIODE SILICO	018	DANA	211083
CR44	211083	DIODE SILICO	018	DANA	211083
CR45	211083	DIODE SILICO	018	DANA	211083
CR46	211083	DIODE SILICO	018	DANA	211083
CR47	211083	DIODE SILICO	018	DANA	211083
CR48	211083	DIODE SILICO	018	DANA	211083
CR49	211083	DIODE SILICO	018	DANA	211083
C01	120230	CAP POLY	.015 MFD 33 V 1%	NPC	
M01	230034	INTEGRATED CIRCUIT		TI	SN7441N
M02	230072	INTEGRATED CIRCUIT		TI	SN7474N
M03	230035	INTEGRATED CIRCUIT		TI	SN7473N
M04	230030	INTEGRATED CIRCUIT		TI	SN7402N
M05	230028	INTEGRATED CIRCUIT		TI	SN7400N
M06	230074	INTEGRATED CIRCUIT		IRC	SN7442N
M07	230029	INTEGRATED CIRCUIT		TI	SN7401N
M08	230030	INTEGRATED CIRCUIT		TI	SN7402N
M09	230029	INTEGRATED CIRCUIT		TI	SN7401N
M10	230073	INTEGRATED CIRCUIT		LIBERTY	SN7405N
Q01	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q02	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q03	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q04	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q05	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q06	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q07	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q08	200087	TRANS SILICO	021	MOTOROLA	SPS1226
Q09	200087	TRANS SILICO	021	MOTOROLA	SPS1226

PARTS LIST

ASSEMBLY 403430 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
Q10	200087	TRANS SILICO		021			MOTOROLA	SPS1226
Q11	200087	TRANS SILICO		021			MOTOROLA	SPS1226
Q12	200037	TRANS SILICO	NPN	2N3646			FAIRCHILD	2N3646
Q13	200037	TRANS SILICO	NPN	2N3646			FAIRCHILD	2N3646
Q14	200087	TRANS SILICO		021			MOTOROLA	SPS1226
R01	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R02	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R03	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R04	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R05	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R06	000514	RES	CARBON	510 K	5%	1/4 W	OHMITE	RC07GF524J
R07	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R08	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R09	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R10	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R11	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R12	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R13	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R14	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R15	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R16	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R17	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R18	000433	RES	CARBON	43 K	5%	1/4 W	OHMITE	RC07GF433J
R19	000302	RES	CARBON	3 K	5%	1/4 W	OHMITE	RC07GF302J
R20	000432	RES	CARBON	4.3 K	5%	1/4 W	OHMITE	RC07GF432J
R21	000432	RES	CARBON	4.3 K	5%	1/4 W	OHMITE	RC07GF432J
R22	000302	RES	CARBON	3 K	5%	1/4 W	OHMITE	RC07GF302J
R23	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R24	000432	RES	CARBON	4.3 K	5%	1/4 W	OHMITE	RC07GF432J
R25	000432	RES	CARBON	4.3 K	5%	1/4 W	OHMITE	RC07GF432J
R26	000432	RES	CARBON	4.3 K	5%	1/4 W	OHMITE	RC07GF432J
R27	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R28	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R29	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R30	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403430 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
R31	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R32	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R33	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R34	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R35	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R36	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R37	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R38	000242	RES	CARBON	2.4 K	5%	1/4 W	OHMITE	RC07GF242J
R39	010568	RES	METAL	1.54 K	.25%	(T-2)	IRC	RN55C
R40	000242	RES	CARBON	2.4 K	5%	1/4 W	OHMITE	RC07GF242J
R41	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R42	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R43	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R44	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R45	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R46	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R47	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R48	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R49	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R50	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R51	000621	RES	CARBON	620 OHM	5%	1/4 W	OHMITE	RC07GF621J
R52	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
S01	600675	SWITCH, ROTARY					DANA	600675
S02	600674	SWITCH, ROTARY					DANA	600674

PARTS LIST

ASSEMBLY 403432 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION					
AR01	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A	
AR02	230109	INTEGRATED CIRCUIT	LM301A - SELECTED		DANA	230109	
AR03	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A	
AR04	230109	INTEGRATED CIRCUIT	LM301A - SELECTED		DANA	230109	
AR05	230056	INTEGRATED CIRCUIT	UA710C		FAIRCHILD	U6A7710393	
CR01	211083	DIODE SILICO	018		DANA	211083	
CR02	211083	DIODE SILICO	018		DANA	211083	
CR03	211083	DIODE SILICO	018		DANA	211083	
CR04	211083	DIODE SILICO	018		DANA	211083	
CR05	211083	DIODE SILICO	018		DANA	211083	
CR06	220026	DIODE ZENER			MOTOROLA	1N963B	
CR07	211083	DIODE SILICO	018		DANA	211083	
CR08	220054	DIODE ZENER			MOTOROLA	1N5260B	
CR09	211236	DIODE SILICO	007		DANA	211236	
CR10	403423	ASSEMBLY, ZENER			DANA	403423	
CR11	211236	DIODE SILICO	007		DANA	211236	
CR12	211236	DIODE SILICO	007		DANA	211236	
CR13	211083	DIODE SILICO	018		DANA	211083	
CR14	211083	DIODE SILICO	018		DANA	211083	
CR15	211083	DIODE SILICO	018		DANA	211083	
CR16	211083	DIODE SILICO	018		DANA	211083	
CR17	211083	DIODE SILICO	018		DANA	211083	
CR18	211083	DIODE SILICO	018		DANA	211083	
CR19	220026	DIODE ZENER			MOTOROLA	1N963B	
CR20	220027	DIODE SILICO ZENER	1N749A		MOTOROLA	1N749A	
CR21	220059	DIODE ZENER					
CR22	220007	DIODE SILICO ZENER	1N751		MOTOROLA	1N751	
C01	110125	CAP TANT	2.2 MFD 35 V		ITT	43212 17122	
C02	110125	CAP TANT	2.2 MFD 35 V		ITT	43212 17122	
C03	101098	CAP CERAM	330 PFD 500 V	10%	AERCVCX	SCD1X5F	
C04	101145	CAP CERAM	100 PFD 500 V	10%	AERCVCX	SCD1X5F	
C05	101145	CAP CERAM	100 PFD 500 V	10%	AERCVCX	SCD1X5F	
C06	120253	CAP	.33 MFD 100 V	1%	TRW	863UW	
C07	110125	CAP TANT	2.2 MFD 35 V		ITT	43212 17122	
C08	101642	CAP CERAM	150 PFD 500 V	10%	AERCVCX	SCD2X5F	

PARTS LIST

ASSEMBLY 403432 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION				
C09	101642	CAP	CERAM	150 PFD 500 V	10%	AERCVOX SCD2X5F
C10	101642	CAP	CERAM	150 PFD 500 V	10%	AERCVOX SCD2X5F
C11	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C12	100012	CAP	CERAM	33 PFD 500 V	10%	AERCVOX TCD-N750
C13	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C14	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C15	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C17	110126	CAP	TANTA	6.8 MFD 35 V		ITT 4312 17168
C18	100012	CAP	CERAM	33 PFD 500 V	10%	AERCVOX TCD-N750
C19	110126	CAP	TANTA	6.8 MFD 35 V		ITT 4312 17168
C20	100038	CAP	CERAM	560 PFD 500 V	5%	AEROVOX TCD-N 750
C21	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C22	110126	CAP	TANTA	6.8 MFD 35 V		ITT 4312 17168
C23	100012	CAP	CERAM	33 PFD 500 V	10%	AERCVOX TCD-N750
C24	110127	CAP	TANT	22 MFD 6.3 V		ITT 43212 12222
C25	110126	CAP	TANTA	6.8 MFD 35 V		ITT 4312 17168
C26	110129	CAP	TANTA	.1MF 35V		ITT 4321217010
C27	110127	CAP	TANT	22 MFD 6.3 V		ITT 43212 12222
C28	110126	CAP	TANTA			ITT 4312 17168
C30	100051	CAP		3 PF		TCD B1-0
C31	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE TH-S10
C32	100068	CAP	CERAM	.02 MFD 100 V	20%	SPRAGUE TG-S20
M01	230028	INTEGRATED CIRCUIT				TI SN7400N
M02	230028	INTEGRATED CIRCUIT				TI SN7400N
Q01	200037	TRANS SILICO NPN		2N3646		FAIRCHILD 2N3646
Q02	200037	TRANS SILICO NPN		2N3646		FAIRCHILD 2N3646
Q03	200037	TRANS SILICO NPN		2N3646		FAIRCHILD 2N3646
Q04	200037	TRANS SILICO NPN		2N3646		FAIRCHILD 2N3646
Q05	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q06	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q07	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q08	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q09	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q10	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q11	200088	TRANS SILICO PNP		2N4248		FAIRCHILD 2N4248
Q12	200043	TRANS SILICO NPN		2N3565		FAIRCHILD 2N3565

PARTS LIST

ASSEMBLY 403432 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
Q13	200162	SWITCHES FET			MATCHED SET		LEDEL	
Q14	200129	TRANS					FAIRCHILD	SE4020
Q15	200162	SWITCHES FET			MATCHED SET		LEDEL	
Q16	200129	TRANS					FAIRCHILD	SE4020
Q17	200162	SWITCHES FET			MATCHED SET		LEDEL	
Q18	200129	TRANS					FAIRCHILD	SE4020
Q19	200088	TRANS SILICO PNP			2N4248		FAIRCHILD	2N4248
Q20	200160	FET					LEDEL	LS4416
Q21	200161	DUAL FET					LEDEL	LS3954
Q22	200088	TRANS SILICO PNP			2N4248		FAIRCHILD	2N4248
Q24	200035	TRANS SILICO NPN			014		DANA	200035
Q25	200088	TRANS SILICO PNP			2N4248		FAIRCHILD	2N4248
Q26	200037	TRANS SILICO NPN			2N3646		FAIRCHILD	2N3646
Q27	200088	TRANS SILICO PNP			2N4248		FAIRCHILD	2N4248
Q28	200160	FET					LEDEL	LS4416
R01	000153	RES	CARBON	15 K	5%	1/4 W	CHMITE	RC07GF153J
R03	000272	RES	CARBON	2.7 K	5%	1/4 W	CHMITE	RC07GF272J
R04	000272	RES	CARBON	2.7 K	5%	1/4 W	CHMITE	RC07GF272J
R05	000153	RES	CARBON	15 K	5%	1/4 W	CHMITE	RC07GF153J
R06	000272	RES	CARBON	2.7 K	5%	1/4 W	CHMITE	RC07GF272J
R07	000272	RES	CARBON	2.7 K	5%	1/4 W	CHMITE	RC07GF272J
R08	000153	RES	CARBON	15 K	5%	1/4 W	CHMITE	RC07GF153J
R09	000511	RES	CARBON	510 OHM	5%	1/4 W	CHMITE	RC07GF511J
R10	000511	RES	CARBON	510 OHM	5%	1/4 W	CHMITE	RC07GF511J
R11	000153	RES	CARBON	15 K	5%	1/4 W	CHMITE	RC07GF153J
R12	000392	RES	CARBON	0003.9 K	5%	1/4 W	CHMITE	RC07GF392J
R13	000104	RES	CARBON	100 K	5%	1/4 W	CHMITE	RC07GF104J
R14	000202	RES	CARBON	2 K	5%	1/4 W	CHMITE	RC07GF202J
R15	000392	RES	CARBON	0003.9 K	5%	1/4 W	CHMITE	RC07GF392J
R16	000392	RES	CARBON	0003.9 K	5%	1/4 W	CHMITE	RC07GF392J
R17	000152	RES	CARBON	1.5 K	5%	1/4 W	CHMITE	RC07GF152J
R18	000104	RES	CARBON	100 K	5%	1/4 W	CHMITE	RC07GF104J
R19	000104	RES	CARBON	100 K	5%	1/4 W	CHMITE	RC07GF104J
R20	000562	RES	CARBON	5.6 K	5%	1/4 W	CHMITE	RC07GF562J
R21	000362	RES	CARBON	3.6 K	5%	1/4 W	OHMITE	RC07GF362J

PARTS LIST

ASSEMBLY 403432 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R22	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R23	000152	RES	CARBON	1.5	K	5%	1/4 W	OHMITE	RC07GF152J
R24	000104	RES	CARBON	100	K	5%	1/4 W	OHMITE	RC07GF104J
R25	000152	RES	CARBON	1.5	K	5%	1/4 W	OHMITE	RC07GF152J
R26	000104	RES	CARBON	100	K	5%	1/4 W	OHMITE	RC07GF104J
R27	000152	RES	CARBON	1.5	K	5%	1/4 W	OHMITE	RC07GF152J
R28	000303	RES	CARBON	30	K	5%	1/4 W	OHMITE	RC07GF303J
R29	000302	RES	CARBON	3	K	5%	1/4 W	OHMITE	RC07GF302J
R30	000302	RES	CARBON	3	K	5%	1/4 W	OHMITE	RC07GF302J
R31	000302	RES	CARBON	3	K	5%	1/4 W	OHMITE	RC07GF302J
R32	010169	RES	METAL	100	K	1%	1/4 W	ELECTRA	RN60D1003F
R33	000105	RES	CARBON	1	M	5%	1/4 W	OHMITE	RC07GF105J
R34	040180	POT		1	M	20%		CTS	360S105B
R35	000123	RES	CARBON	12	K	5%	1/4 W	OHMITE	RC07GF123J
R36	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R37	010582	RES	METAL	30.1	K	1%	T-0	IRC	RN55D3012F
R38	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R39	010580	RES	METAL	21	K	1%	T-0	IRC	RN55D2102F
R40	010582	RES	METAL	30.1	K	1%	T-0	IRC	RN55D3012F
R41	010647	RES	METAL	316	OHM	1%		IRC	RN65E3160F
R42	000270	RES	CARBON	27	OHM	5%	1/4 W	OHMITE	RC07GF270J
R43	040174	POT	CERMET	500	OHM			BECKMAN	79PR500
R44	010645	RES	METAL			1%	T-0	IRC	RN55D2371F
R45	403423	ASSEMBLY ZENER						DANA	403423
R46	000513	RES	CARBON	51	K	5%	1/4 W	OHMITE	RC07GF513J
R47	000562	RES	CARBON	5.6	K	5%	1/4 W	OHMITE	RC07GF562J
R48	000435	RES	CARBON	4.3	M	5%	1/4 W	OHMITE	RC07GF435J
R51	000302	RES	CARBON	3	K	5%	1/4 W	OHMITE	RC07GF302J
R53	000306	RES	CARBON	30	M	5%	1/4 W	OHMITE	RC07GF306J
R54	000156	RES	CARBON	15	M	5%	1/4 W	OHMITE	RC07GF156J
R55	040210	POT	CERMET	100	K		1 W	CTS	360S104B
R56	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R57	000752	RES	CARBON	7.5	K	5%	1/4 W	OHMITE	RC07GF752J
R58	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R59	040113	RES	VARI	100	K	10%		BECKMAN	79P100K

PARTS LIST

ASSEMBLY 403432 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION								
R60	000515	RES	CARBON	5.1	M	5%	1/4	W	OHMITE	RC07GF515J
R61	010586	RES		5	K	.02%			VISHAY	V53-1-M
R62	010646	RES	METAL			1%	T-0		IRC	RN55D2491F
R63	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R64	010586	RES		5	K	.02%			VISHAY	V53-1-M
R65	000306	RES	CARBON	30	M	5%	1/4	W	OHMITE	RC07GF306J
R66	000183	RES	CARBON	18	K	5%	1/4	W	OHMITE	RC07GF183J
R67	000156	RES	CARBON	15	M	5%	1/4	W	OHMITE	RC07GF156J
R68	040210	POT	CERMET	100	K		1	W	CTS	360S104B
R69	000392	RES	CARBON	0003.9	K	5%	1/4	W	OHMITE	RC07GF392J
R70	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R71	000202	RES	CARBON	2	K	5%	1/4	W	OHMITE	RC07GF202J
R72	000200	RES	CARBON	20	OHM	5%	1/4	W	OHMITE	RC07GF200J
R73	010585	RES		3.6	K	.02%			VISHAT	V53-1
R74	000153	RES	CARBON	15	K	5%	1/4	W	OHMITE	RC07GF153J
R77	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R78	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R79	000330	RES	CARBON	33	K	5%	1/4	W	OHMITE	RC07GF330J
R80	000302	RES	CARBON	3	K	5%	1/4	W	OHMITE	RC07GF302J
R81	040190	POT	CERMET	500	OHM				BECKMAN	62PAR500Z
R82	000104	RES	CARBON	100	K	5%	1/4	W	OHMITE	RC07GF104J
R83	040211	POT	CERMET	500	OHM	20%			CTS	360S Series
T01	403553	TRANSFORMER, PULSE							DANA	403553
T02	403553	TRANSFORMER, PULSE							DANA	403553
T03	403553	TRANSFORMER, PULSE							DANA	403553

PARTS LIST

ASSEMBLY 403434 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION						
AR01	230075	INTEGRATED CIRCUIT					FAIRCHILD	UA748C
AR02	230054	INTEGRATED CIRCUIT	LM301A				NAT SEMI	LM301A
CR01	220027	DIODE SILICO ZENER	1N749A				MOTOROLA	1N749A
CR02	220027	DIODE SILICO ZENER	1N749A				MOTOROLA	1N749A
CR07	220027	DIODE SILICO ZENER	1N749A				MOTOROLA	1N749A
CR08	211083	DIODE SILICO	018				DANA	211083
CR09	211083	DIODE SILICO	018				DANA	211083
CR10	221177	DIODE SILICO ZENER			1/4 W		MOTOROLA	M.2.4A25
CR11	220007	DIODE SILICO ZENER	1N751				MOTOROLA	1N751
CR12	220007	DIODE SILICO ZENER	1N751				MOTOROLA	1N751
CR13	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR14	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR15	211083	DIODE SILICO	018				DANA	211083
CR16	211083	DIODE SILICO	018				DANA	211083
CR17	211083	DIODE SILICO	018				DANA	211083
CR18	211083	DIODE SILICO	018				DANA	211083
CR19	211083	DIODE SILICO	018				DANA	211083
C01	120237	CAP POLY	.15 MFD	100 V	5%		NPC	KSC Series
C02	120237	CAP POLY	.15 MFD	100 V	5%		NPC	KSC Series
C03	121394	CAP MYLAR	.15 MFD	100 V	10%		CDE	WMF1P15
C04	101145	CAP CERAM	100 PFD	500 V	10%		AERCVCX	SCD1X5F
C05	121091	CAP MYLAR	.033 MFD	100 V	10%		CDE	WMF1533
C06	120070	CAP POLY	3000 PFD	100 V	5%		NPC	KSC Series
C07	100025	CAP CERAM	.005 MFD	100 V	20%		ERIE	835-000-X5V05
C08	120257	CAP POLY	5 PFD	630 V			NPC	KSO Series
C09	100051	CAP	3 PF				TCD	B1-0
C10	100012	CAP CERAM	33 PFD	500 V	10%		AERCVCX	TCD-N750
C11	121091	CAP MYLAR	.033 MFD	100 V	10%		CDE	WMF1533
C12	110125	CAP TANT	2.2 MFD	35 V			ITT	43212 17122
C13	110125	CAP TANT	2.2 MFD	35 V			ITT	43212 17122
C14	120257	CAP POLY	5 PFD	630 V			NPC	KSO Series
K01	310077	REED RELAY, SHIELD					ELECTROL	R2691-3
Q01	200136	TRANS					FAIRCHILD	SE4022
Q02	200136	TRANS					FAIRCHILD	SE4022
Q03	200088	TRANS SILICO PNP	2N4248				FAIRCHILD	2N4248

PARTS LIST

ASSEMBLY 403434 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION							
Q04	201084	TRANS GERMAN PNP			2N1304			TI	2N1304
Q05	200137	TRANS						FAIRCHILD	2N4248
Q06	200137	TRANS						FAIRCHILD	2N4248
Q07	200140	TRANS DUAL			TYPE 140 NPN			DANA	200140
Q08	200140	TRANS DUAL			TYPE 140 NPN			DANA	200140
Q09	200142	TRANS						FAIRCHILD	2N4249
Q10	200035	TRANS SILICO NPN			014			DANA	200035
Q11	200035	TRANS SILICO NPN			014			DANA	200035
Q12	200142	TRANS						FAIRCHILD	2N4249
Q13	200035	TRANS SILICO NPN			014			DANA	200035
Q14	200035	TRANS SILICO NPN			014			DANA	200035
Q15	200137	TRANS						FAIRCHILD	2N4248
Q16	200137	TRANS						FAIRCHILD	2N4248
Q17	200137	TRANS						FAIRCHILD	2N4248
Q18	200137	TRANS						FAIRCHILD	2N4248
Q19	200137	TRANS						FAIRCHILD	2N4248
Q20	200137	TRANS						FAIRCHILD	2N4248
R01	010536	RES	METAL		100 K	1%	T-0	IRC	RN55D1003F
R02	010621	RES	METAL FILM		49.9 K	1%		IRC	RN55C
R03	000245	RES	CARBON	2.4 M		5%	1/4 W	OHMITE	RC07GF245J
R04	000153	RES	CARBON	15 K		5%	1/4 W	OHMITE	RC07GF153J
R05	000202	RES	CARBON	2 K		5%	1/4 W	OHMITE	RC07GF202J
R06	000220	RES	CARBON	22 OHM		5%	1/4 W	OHMITE	RC07GF220J
R07	000912	RES	CARBON	9.1 K		5%	1/4 W	OHMITE	RC07GF912J
R08	020582	RES		18 K		5%	3 W	C-F	M-20
R09	000103	RES	CARBON	10 K		5%	1/4 W	OHMITE	RC07GF103J
R10	010529	RES		10 K		1%		IRC	RN55D
R11	000181	RES	CARBON	180 OHM		5%	1/4 W	OHMITE	RC07GF181J
R12	040113	RES	VARI	100 K		10%		BECKMAN	79P100K
R13	000107	RES	CARBON	100 M		5%	1/4 W	OHMITE	RC07GF107J
R14	001737	RES	FSV			5%	1/4 W	DANA	001737
R15	010584	RES	SET	T-2			1%	PYROFILM	PME70
R16	001737	RES	FSV			5%	1/4 W	DANA	001737
R17	010584	RES	SET	T-2			1%	PYROFILM	PME70
R18	000221	RES	CARBON	220 OHM		5%	1/4 W	OHMITE	RC07GF221J

PARTS LIST

ASSEMBLY 403434 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION							
R19	011178	RES	METAL	4.99 K	1%	1/4 W	ELECTRA	RN20X4994F	
R20	000622	RES	CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J	
R21	000430	RES	CARBON	43 OHM	5%	1/4 W	OHMITE	RC07GF430J	
R22	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J	
R23	000681	RES	CARBON	680 OHM	5%	1/4 W	OHMITE	RC07GF681J	
R24	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J	
R25	000821	RES	CARBON	820 OHM	5%	1/4 W	OHMITE	RC07GF821J	
R26	000273	RES	CARBON	27 K	5%	1/4 W	OHMITE	RC07GF273J	
R27	000330	RES	CARBON	33 K	5%	1/4 W	OHMITE	RC07GF330J	
R28	000161	RES	CARBON	160 OHM	5%	1/4 W	OHMITE	RC07GF161J	
R29	000111	RES	CARBON	110 OHM	5%	1/4 W	OHMITE	RC07GF111J	
R30	000220	RES	CARBON	22 OHM	5%	1/4 W	OHMITE	RC07GF220J	
R31	000430	RES	CARBON	43 OHM	5%	1/4 W	OHMITE	RC07GF430J	
R32	000820	RES	CARBON	82 OHM	5%	1/4 W	OHMITE	RC07GF820J	
R33	000273	RES	CARBON	27 K	5%	1/4 W	OHMITE	RC07GF273J	
R34	000100	RES	CARBON	10 OHM	5%	1/4 W	OHMITE	RC07GF100J	
R35	000435	RES	CARBON	4.3 M	5%	1/4 W	OHMITE	RC07GF435J	
R36	040113	RES	VARI	100 K	10%		BECKMAN	79P100K	

PARTS LIST

ASSEMBLY 403464 – Model 4800

REF DES	PART NO.	DESCRIPTION							
CR01	211083	DIODE	SILICO		018			DANA	211083
CR02	211083	DIODE	SILICO		018			DANA	211083
CR03	220007	DIODE	SILICO	ZENER	1N751			MOTOROLA	1N751
CR04	220007	DIODE	SILICO	ZENER	1N751			MOTOROLA	1N751
C01	121091	CAP	MYLAR	.033 MFD	100 V	10%		CDE	WMF1533
C02	100012	CAP	CERAM	33 PFD	500 V	10%		AEROVOX	TCD-N750
C03	120001	CAP	MYLAR	.0033 MFD	100 V	10%		CDE	WMF1D33
C04	121093	CAP	MYLAR	.047 MFD	100 V	10%		CDE	WMF1S47
C05	100017	CAP	CERAM	.01 MFD	200 V	10%		SPRAGUE	TH-S10
C06	100012	CAP	CERAM	33 PFD	500 V	10%		AEROVOX	TCD-N750
C07	100017	CAP	CERAM	.01 MFD	200 V	10%		SPRAGUE	TH-S10
C08	100012	CAP	CERAM	33 PFD	500 V	10%		AEROVOX	TCD-N750
M01	403494	AMP KIT	FSV				1/4W	DANA	403494
M02	230054	INTEGRATED CIRCUIT			LM301A			NAT SEMI	LM301A
M03	230054	INTEGRATED CIRCUIT			LM301A			NAT SEMI	LM301A
Q01	200137	TRANS						FAIRCHILD	2N4248
Q02	200137	TRANS						FAIRCHILD	2N4248
Q03	200088	TRANS	SILICO	PNP	2N4248			FAIRCHILD	2N4248
Q04	200035	TRANS	SILICO	NPN	014			DANA	200035
Q05	200035	TRANS	SILICO	NPN	014			DANA	200035
Q06	201084	TRANS	GERMAN	PNP	2N1304			TI	2N1304
Q07	200137	TRANS						FAIRCHILD	2N4248
Q08	200137	TRANS						FAIRCHILD	2N4248
R01	403494	AMP KIT	FSV				1/4W	DANA	403494
R02	021154	RES	WW	10 K		3%	1/4W	C-F	C-FM20
R03	021154	RES	WW	10 K		3%	1/4W	C-F	C-FM20
R04	010734	RES		200 OHM		.05%		VISHAY	V53-1M Series
R05	010653	RES	METAL	19.81 K		.05%		VISHAY	
R06	010732	RES		4.8 K		1%		VISHAY	V53-1M Series
R07	011178	RES	METAL	4.99 K		1%		ELECTRA	RN20X4994F
R08	403494	AMP KIT	FSV				1/4W	DANA	403494
R09	000514	RES	CARBON	510 K		5%	1/4W	OHMITE	RC07GF524J
R10	040085	RES	VARI	500 K		30%		BECKMAN	79PR500K
R11	000106	RES	CARBON	10 M		5%	1/4W	OHMITE	RC07GF106J
R12	000472	RES	CARBON	4.7 K		5%	1/4W	OHMITE	RC07GF472J

PARTS LIST

ASSEMBLY 403464 – Model 4800

REF DES	PART NO.	DESCRIPTION						
R13	040113	RES	VARI	100 K	10%		BECKMAN	79P100K
R14	000182	RES	CARBON	1.8 K	5%	1/4W	OHMITE	RC07GF182J
R15	000202	RES	CARBON	2 K	5%	1/4W	OHMITE	RC07GF202J
R16	000563	RES	CARBON	56 K	5%	1/4W	OHMITE	RC07GF563J
R17	000101	RES	CARBON	100 OHM	5%	1/4W	OHMITE	RC07GF101J
R18	000221	RES	CARBON	220 OHM	5%	1/4W	OHMITE	RC07GF221J
R19	000101	RES	CARBON	100 OHM	5%	1/4W	OHMITE	RC07GF101J
R20	040113	RES	VARI	100 K	10%		BECKMAN	79P100K
R21	000472	RES	CARBON	4.7 K	5%	1/4W	OHMITE	RC07GF472J
R22	000181	RES	CARBON	180 OHM	5%	1/4W	OHMITE	RC07GF181J
R23	001100	RES	CARBON	2.2 K	5%	1/2W	OHMITE	RC20GF222J
R24	001100	RES	CARBON	2.2 K	5%	1/2W	OHMITE	RC20GF222J
R25	010654	RES		20 K	.05%		VISHAY	V53-1
R26	000682	RES	CARBON	6.8 K	5%	1/4W	OHMITE	RC07GF682J
R27	010615	RES		10 K	.02%		VISHAY	V53-1
R28	010654	RES		20 K	.05%		VISHAY	V53-1

PARTS LIST

ASSEMBLY 403435 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
CR01	220011	DIODE SILICO ZENER 1N968A						MOTORCLA	1N968A
CR02	211083	DIODE SILICO 018						DANA	211083
CR03	211083	DIODE SILICO 018						DANA	211083
CR04	211236	DIODE SILICO 007						DANA	211236
CR05	211083	DIODE SILICO 018						DANA	211083
CR06	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR07	211083	DIODE SILICO 018						DANA	211083
CR08	211083	DIODE SILICO 018						DANA	211083
CR10	211083	DIODE SILICO 018						DANA	211083
CR11	211083	DIODE SILICO 018						DANA	211083
CR12	211083	DIODE SILICO 018						DANA	211083
CR13	211083	DIODE SILICO 018						DANA	211083
CR14	211083	DIODE SILICO 018						DANA	211083
CR15	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR16	211083	DIODE SILICO 018						DANA	211083
CR17	211083	DIODE SILICO 018						DANA	211083
CR18	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR19	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR20	220011	DIODE SILICO ZENER 1N968A						MOTORCLA	1N968A
CR21	22C06C	DIODE ZENER			24 V	5%		MOTOROLA	1N970B
C01	120034	CAP POLYS	100	PFD	500 V	5%		CRL	CPR-100J
C02	100017	CAP CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10	
C03	121091	CAP MYLAR	.033	MFD	100 V	10%		CDE	WMF1533
C04	100012	CAP CERAM	33	PFD	500 V	10%		AERCVCX	TCD-N750
C05	100008	CAP CERAM	82	PFD	500 V	10%		AERCVCX	TCD-N750
C06	120001	CAP MYLAR	.0033	MFD	100 V	10%		CDE	WMF1D33
C07	100017	CAP CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10	
C08	121093	CAP MYLAR	.047	MFD	100 V	10%		CDE	WMF1S47
C09	120001	CAP MYLAR	.0033	MFD	100 V	10%		CDE	WMF1D33
C10	100017	CAP CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10	
C11	100012	CAP CERAM	33	PFD	500 V	10%		AERCVCX	TCD-N750
C12	100017	CAP CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10	
C13	100012	CAP CERAM	33	PFD	500 V	10%		AERCVCX	TCD-N750
C14	110129	CAP TANTA	.1MF		35V			ITT	4321217010

PARTS LIST

ASSEMBLY 403435 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION				
K01	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K02	310078	REED RELAY, SHIELD			ELECTROL	R2690-3
K03	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K04	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K05	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
M01	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M02	403494	AMP KIT	FSV	1/4 W	DANA	403393
M03	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M04	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M05	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
Q01	200160	FET			LEDEL	LS4416
Q02	200137	TRANS			FAIRCHILD	2N4248
Q03	200137	TRANS			FAIRCHILD	2N4248
Q04	200137	TRANS			FAIRCHILD	2N4248
Q05	200137	TRANS			FAIRCHILD	2N4248
Q06	200135	FET KIT			DANA	200135
Q07	200068	TRANS	2N4250		FAIRCHILD	2N4250
Q08	200088	TRANS SILICO PNP	2N4248		FAIRCHILD	2N4248
Q09	200043	TRANS SILICO NPN	2N3565		FAIRCHILD	2N3565
Q10	200088	TRANS SILICO PNP	2N4248		FAIRCHILD	2N4248
Q11	200035	TRANS SILICO NPN	014		DANA	200035
Q12	200160	FET			LEDEL	LS4416
Q13	200035	TRANS SILICO NPN	014		DANA	200035
Q14	201084	TRANS GERMAN PNP	2N1304		TI	2N1304
Q15	200011	TRANS SILICO PNP	009		DANA	200011
Q16	200011	TRANS SILICO PNP	009		DANA	200011
Q17	200137	TRANS			FAIRCHILD	2N4248
Q18	200137	TRANS			FAIRCHILD	2N4248
Q19	200137	TRANS			FAIRCHILD	2N4248
R01	000203	RES CARBON	20 K	5% 1/4 W	CHMITE	RC07GF203J
R02	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20
R04	010741	RES CARBON	FSV	1%		
R05	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20
R06	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20

PARTS LIST

ASSEMBLY 403435 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
CR01	220011	DIODE SILICO ZENER 1N968A						MOTORCLA	1N968A
CR02	211083	DIODE SILICO 018						DANA	211083
CR03	211083	DIODE SILICO 018						DANA	211083
CR04	211236	DIODE SILICO 007						DANA	211236
CR05	211083	DIODE SILICO 018						DANA	211083
CR06	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR07	211083	DIODE SILICO 018						DANA	211083
CR08	211083	DIODE SILICO 018						DANA	211083
CR10	211083	DIODE SILICO 018						DANA	211083
CR11	211083	DIODE SILICO 018						DANA	211083
CR12	211083	DIODE SILICO 018						DANA	211083
CR13	211083	DIODE SILICO 018						DANA	211083
CR14	211083	DIODE SILICO 018						DANA	211083
CR15	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR16	211083	DIODE SILICO 018						DANA	211083
CR17	211083	DIODE SILICO 018						DANA	211083
CR18	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR19	220007	DIODE SILICO ZENER 1N751						MOTORCLA	1N751
CR20	220011	DIODE SILICO ZENER 1N968A						MOTORCLA	1N968A
CR21	22C06C	DIODE ZENER			24	V	5%	MOTOROLA	1N970B
C01	120034	CAP	POLYS	100	PFD	500 V	5%	CRL	CPR-100J
C02	100017	CAP	CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10
C03	121091	CAP	MYLAR	.033	MFD	100 V	10%	CDE	WMF1533
C04	100012	CAP	CERAM	33	PFD	500 V	10%	AERCVCX	TCD-N750
C05	100008	CAP	CERAM	82	PFD	500 V	10%	AERCVCX	TCD-N750
C06	120001	CAP	MYLAR	.0033	MFD	100 V	10%	CDE	WMF1D33
C07	100017	CAP	CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10
C08	121093	CAP	MYLAR	.047	MFD	100 V	10%	CDE	WMF1S47
C09	120001	CAP	MYLAR	.0033	MFD	100 V	10%	CDE	WMF1D33
C10	100017	CAP	CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10
C11	100012	CAP	CERAM	33	PFD	500 V	10%	AERCVCX	TCD-N750
C12	100017	CAP	CERAM	.01	MFD	200 V	10%	SPRAGUE	TH-S10
C13	100012	CAP	CERAM	33	PFD	500 V	10%	AERCVCX	TCD-N750
C14	110129	CAP	TANTA	.1MF		35V		ITT	4321217010

PARTS LIST

ASSEMBLY 403435 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION				
K01	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K02	310078	REED RELAY, SHIELD			ELECTROL	R2690-3
K03	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K04	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
K05	310077	REED RELAY, SHIELD			ELECTROL	R2691-3
M01	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M02	403494	AMP KIT	FSV	1/4 W	DANA	403393
M03	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M04	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
M05	230054	INTEGRATED CIRCUIT	LM301A		NAT SEMI	LM301A
Q01	200160	FET			LEDEL	LS4416
Q02	200137	TRANS			FAIRCHILD	2N4248
Q03	200137	TRANS			FAIRCHILD	2N4248
Q04	200137	TRANS			FAIRCHILD	2N4248
Q05	200137	TRANS			FAIRCHILD	2N4248
Q06	200135	FET KIT			DANA	200135
Q07	200068	TRANS	2N4250		FAIRCHILD	2N4250
Q08	200088	TRANS SILICO PNP	2N4248		FAIRCHILD	2N4248
Q09	200043	TRANS SILICO NPN	2N3565		FAIRCHILD	2N3565
Q10	200088	TRANS SILICO PNP	2N4248		FAIRCHILD	2N4248
Q11	200035	TRANS SILICO NPN	014		DANA	200035
Q12	200160	FET			LEDEL	LS4416
Q13	200035	TRANS SILICO NPN	014		DANA	200035
Q14	201084	TRANS GERMAN PNP	2N1304		TI	2N1304
Q15	200011	TRANS SILICO PNP	009		DANA	200011
Q16	200011	TRANS SILICO PNP	009		DANA	200011
Q17	200137	TRANS			FAIRCHILD	2N4248
Q18	200137	TRANS			FAIRCHILD	2N4248
Q19	200137	TRANS			FAIRCHILD	2N4248
R01	000203	RES CARBON	20 K	5% 1/4 W	CHMITE	RC07GF203J
R02	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20
R04	010741	RES CARBON	FSV	1%		
R05	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20
R06	021154	RES WW	10 K	3% 1/4 W	C-F	C-FM20

PARTS LIST

ASSEMBLY 403435 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R07	010671	RES		494.8	K	.25%	T-0	PYROFILM	PME60
R08	010615	RES		10	K	.02%		VISHAY	V53-1
R09	010615	RES		10	K	.02%		VISHAY	V53-1
R10	020611	RES		200	OHM	.02%		NANSISTOR	5Q12A
R11	020615	RES	WW	4.8	K	1%		NANISTOR	5Q12A
R12	010621	RES	METAL FILM	49.9	K	1%		IRC	RN55C
R13	010621	RES	METAL FILM	49.9	K	1%		IRC	RN55C
R14	200135	FET	KIT					DANA	200135
R15	200135	FET	KIT					DANA	200135
R16	001737	RES	FSV			5%	1/4 W	DANA	001737
R17	000472	RES	CARBON	4.7	K	5%	1/4 W	CHMITE	RC07GF472J
R18	000151	RES	CARBON	150	OHM	5%	1/4 W	CHMITE	RC07GF151J
R19	040173	POT	CERMET	5	K			BECKMAN	79PR5K
R20	000106	RES	CARBON	10	M	5%	1/4 W	CHMITE	RC07GF106J
R21	000514	RES	CARBON	510	K	5%	1/4 W	CHMITE	RC07GF524J
R22	001737	RES	FSV			5%	1/4 W	DANA	001737
R23	040169	POT	CERMET	20	OHM	20%		BECKMAN	70PR20
R24	010652	RES		4.99	K	.05%		VISHAY	V53-1
R25	040113	RES	VARI	100	K	10%		BECKMAN	79P100K
R26	000244	RES	CARBON	240	K	5%	1/4 W	CHMITE	RC07GF244J
R27	010091	RES	METAL	11	K	1%	1/4 W	ELECTRA	RN60D1102F
R28	000182	RES	CARBON	1.8	K	5%	1/4 W	CHMITE	RC07GF182J
R29	040113	RES	VARI	100	K	10%		BECKMAN	79P100K
R30	010703	RES	METAL	555.50	OHM	.05%		VISHAY	V53-1
R31	000113	RES	CARBON	11	K	5%	1/4 W	CHMITE	RC07GF113J
R32	000202	RES	CARBON	2	K	5%	1/4 W	CHMITE	RC07GF202J
R33	000563	RES	CARBON	56	K	5%	1/4 W	CHMITE	RC07GF563J
R34	000101	RES	CARBON	100	OHM	5%	1/4 W	CHMITE	RC07GF101J
R35	040168	POT	CERMET	200	OHM	10%		BECKMAN	79PR200
R36	020604	RES		100	K	.05%		JORDAN	J-11
R37	040182	POT		250	K	20%		CTS	360S254B
R38	010682	RES	CARBON	9.8	M	1%		DALE	DCS1/2
R39	000203	RES	CARBON	20	K	5%	1/4 W	CHMITE	RC07GF203J
R40	000101	RES	CARBON	100	OHM	5%	1/4 W	CHMITE	RC07GF101J
R41	000221	RES	CARBON	220	OHM	5%	1/4 W	CHMITE	RC07GF221J

PARTS LIST

ASSEMBLY 403435 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R42	040112	RES	VARI	2	K			BECKMAN	79PR2K
R43	020612	RES		1.009	M	.05%		JORDAN	J-12
R44	040172	POT	CERMET	50	K			BECKMAN	79PR50K
R45	010655	RES		11.086	M	.1%	T-9	PYROFILM	PME70
R46	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R47	010654	RES		20	K	.05%		VISHAY	V53-1
R49	010615	RES		10	K	.02%		VISHAY	V53-1
R50	040113	RES	VARI	100	K	10%		BECKMAN	79P100K
R51	010656	RES		19.948	M	.1%	T-9	PYROFILM	PME75
R52	010615	RES		10	K	.02%		VISHAY	V53-1
R53	010586	RES		5	K	.02%		VISHAY	V53-1-M
R54	040113	RES	VARI	100	K	10%		BECKMAN	79P100K
R55	000472	RES	CARBON	4.7	K	5%	1/4 W	OHMITE	RC07GF472J
R56	000181	RES	CARBON	180	OHM	5%	1/4 W	OHMITE	RC07GF181J
R57	001100	RES	CARBON	2.2	K	5%	1/2 W	OHMITE	RC20GF222J
R58	010654	RES		20	K	.05%		VISHAY	V53-1
R59	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R60	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R61	000273	RES	CARBON	27	K	5%	1/4 W	OHMITE	RC07GF273J
R62	000331	RES	CARBON	330	OHM	5%	1/4 W	OHMITE	RC07GF331J
R63	000680	RES	CARBON	68	OHM	5%	1/4 W	OHMITE	RC07GF680J
R64	000222	RES	CARBON	2.2	K	5%	1/4 W	OHMITE	RC07GF222J
R65	001100	RES	CARBON	2.2	K	5%	1/2 W	OHMITE	RC20GF222J
R66	040085	RES	VARI	500	K	30%		BECKMAN	79PR500K
R67	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R68	403494	AMP KIT		FSV			1/4 W	DANA	403494
R69	403494	AMP KIT		FSV			1/4 W	DANA	403494
R03	020614	RES		19.81	K	.01%		JORDAN	J-11
R48	000682	RES	CARBON	6.8	K	5%	1/4 W	OHMITE	RC07GF682J
R70	403494	AMP KIT		FSV			1/4 W	DANA	403494
R71	403494	AMP KIT		FSV			1/4 W	DANA	403494

PARTS LIST

ASSEMBLY 403431 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION			
CR01	210021	DIODE		DANA	210021
CR02	210021	DIODE		DANA	210021
CR03	210021	DIODE		DANA	210021
CR04	210021	DIODE		DANA	210021
CR05	211083	DIODE SILICO	018	DANA	211083
CR06	220007	DIODE SILICO ZENER	1N751	MOTORCLA	1N751
CR07	211083	DIODE SILICO	018	DANA	211083
CR08	211083	DIODE SILICO	018	DANA	211083
CR09	211083	DIODE SILICO	018	DANA	211083
CR10	211083	DIODE SILICO	018	DANA	211083
CR11	211083	DIODE SILICO	018	DANA	211083
CR12	211083	DIODE SILICO	018	DANA	211083
CR13	211083	DIODE SILICO	018	DANA	211083
CR14	211083	DIODE SILICO	018	DANA	211083
CR15	211083	DIODE SILICO	018	DANA	211083
C01	100040	CAP	200 PF 1000 V	SPRAGUE	5GA-T20
K01	310060	RELAY	1000 V	P&B	R10E1223-2
K02	310060	RELAY	1000 V	P&B	R10E1223-2
K03	310060	RELAY	1000 V	P&B	R10E1223-2
M01	230073	INTEGRATED CIRCUIT		LIBERTY	SN7405N
M02	230029	INTEGRATED CIRCUIT		TI	SN7401N
M03	230073	INTEGRATED CIRCUIT		LIBERTY	SN7405N
M04	230034	INTEGRATED CIRCUIT		TI	SN7441N
Q01	200037	TRANS SILICO NPN	2N3646	FAIRCHILD	2N3646
Q02	200037	TRANS SILICO NPN	2N3646	FAIRCHILD	2N3646
Q03	200037	TRANS SILICO NPN	2N3646	FAIRCHILD	2N3646
Q04	200037	TRANS SILICO NPN	2N3646	FAIRCHILD	2N3646
Q05	200132	TRANS		FAIRCHILD	FPT100
Q06	200132	TRANS		FAIRCHILD	FPT100
Q07	200132	TRANS		FAIRCHILD	FPT100
Q08	200132	TRANS		FAIRCHILD	FPT100
Q09	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q10	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q11	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q12	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565

PARTS LIST

ASSEMBLY 403431 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
Q13	200037	TRANS SILICO NPN			2N3646			FAIRCHILD	2N3646
Q14	200037	TRANS SILICO NPN			2N3646			FAIRCHILD	2N3646
Q15	200037	TRANS SILICO NPN			2N3646			FAIRCHILD	2N3646
R01	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R02	000182	RES	CARBON	1.8 K	5%	1/4 W		OHMITE	RC07GF182J
R03	000182	RES	CARBON	1.8 K	5%	1/4 W		OHMITE	RC07GF182J
R04	000182	RES	CARBON	1.8 K	5%	1/4 W		OHMITE	RC07GF182J
R05	000182	RES	CARBON	1.8 K	5%	1/4 W		OHMITE	RC07GF182J
R06	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R07	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R08	000750	RES	CARBON	75 OHM	5%	1/4 W		OHMITE	RC07GF750J
R09	000750	RES	CARBON	75 OHM	5%	1/4 W		OHMITE	RC07GF750J
R10	000750	RES	CARBON	75 OHM	5%	1/4 W		OHMITE	RC07GF750J
R11	000750	RES	CARBON	75 OHM	5%	1/4 W		OHMITE	RC07GF750J
R12	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R13	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R14	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R15	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R16	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R17	000203	RES	CARBON	20 K	5%	1/4 W		OHMITE	RC07GF203J
R18	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R19	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R20	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R21	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R22	000103	RES	CARBON	10 K	5%	1/4 W		OHMITE	RC07GF103J
R23	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R24	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R25	001758	RES	CARBON	330 OHM	5%	1 W		OHMITE	RC32GF331J
R26	001784	RES		910 OHM	5%	1/2 W			
R27	000305	RES	CARBON	3 M	5%	1/4 W		OHMITE	RC07GF305J

PARTS LIST

ASSEMBLY 403470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
AR01	230091	INTEGRATED CIRCUIT			UA725		DANA	230091
AR02	230091	INTEGRATED CIRCUIT			UA725		DANA	230091
AR03	230091	INTEGRATED CIRCUIT			UA725		DANA	230091
AR04	230070	INTEGRATED CIRCUIT			UA725		FAIRCHILD	U5B7725393
B01	920563	BEADS					FERX CBE	56-59065-4B
B02	920563	BEADS					FERX CBE	56-59065-4B
B03	920563	BEADS					FERX CBE	56-59065-4B
B04	920563	BEADS					FERX CBE	56-59065-4B
B05	920563	BEADS					FERX CBE	56-59065-4B
B06	920563	BEADS					FERX CBE	56-59065-4B
CR01	211083	DIODE SILICO			018		DANA	211083
CR02	220016	DIODE SILICO ZENER			1N964B		MOTOROLA	1N964B
CR03	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR04	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR05	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR06	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR07	210035	DIODE					HP	5082-2810
CR08	210035	DIODE					HP	5082-2810
CR09	210035	DIODE					HP	5082-2810
CR10	210035	DIODE					HP	5082-2810
CR11	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR12	220004	DIODE SILICO ZENER			1N961B		MOTOROLA	1N961B
CR13	210035	DIODE					HP	5082-2810
CR14	210035	DIODE					HP	5082-2810
C04	130131	CAP		20 PFD	100 V		AMPEREX	C010KA/20E
C05	100085	CAP	CERAM	6.8 PFD	1 KV		SPRAGUE	10TCC-V68
C06	100081	CAP		4.7 PFD	1000 V		SPRAGUE	C030B102E4R7D
C07	100085	CAP	CERAM	6.8 PFD	1 KV		SPRAGUE	10TCC-V68
C08	130131	CAP		20 PFD	100 V		AMPEREX	C010KA/20E
C09	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C10	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10

PARTS LIST

ASSEMBLY 403470 - Model 4800

A

REF. DESIG.	PART NO.	DESCRIPTION					
C11	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C12	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C13	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C14	100081	CAP		4.7 PFD 1000 V		SPRAGUE	C030B102E4R7D
C15	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C16	110151	CAP		10 MFD 25 V		ITT	43212-16210
C17	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C18	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C19	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C20	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C21	101098	CAP	CERAM	330 PFD 500 V	10%	AERCVCX	SCD1X5F
C22	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C23	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C24	101098	CAP	CERAM	330 PFD 500 V	10%	AERCVCX	SCD1X5F
C25	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C26	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C27	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C29	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C30	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C32	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C33	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C34	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C35	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C36	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C38	110151	CAP		10 MFD 25 V		ITT	43212-16210
C40	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C41	130131	CAP		20 PFD 100 V		AMPEREX	C010KA/20E
C42	120025	CAP	MYLAR	1.5 MFD 100 V	10%	IMB	XA2B1551C
C43	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C44	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C45	100068	CAP	CERAM	.02 MFD 100 V	20%	SPRAGUE	TG-S20

PARTS LIST

ASSEMBLY 4C3470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION					
C46	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C47	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C48	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C49	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C50	100081	CAP		4.7 PFD 1000 V		SPRAGUE	C030B102E4R7D
C51	100080	CAP		.05 MFD 100 V	20%	SPRAGUE	TG-S50
C52	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C53	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C54	101098	CAP	CERAM	330 PFD 500 V	10%	AERCVCX	SCD1X5F
C55	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C56	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C58	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C59	110126	CAP	TANTA	6.8 MFD 35 V		ITT	4312 17168
C60	100017	CAP	CERAM	.01 MFD 200 V	10%	SPRAGUE	TH-S10
C61	110151	CAP		10 MFD 25 V		ITT	43212-16210
Q01	200179	TRANS, FET				MOTOROLA	2N4391
Q02	200129	TRANS				FAIRCHILD	SE4020
Q03	200176	TRANS				FAIRCHILD	SE3005
Q04	200176	TRANS				FAIRCHILD	SE3005
Q05	200176	TRANS				FAIRCHILD	SE3005
Q06	200178	TRANS				FAIRCHILD	2N5910
Q07	200176	TRANS				FAIRCHILD	SE3005
Q08	200178	TRANS				FAIRCHILD	2N5910
Q09	200176	TRANS				FAIRCHILD	SE3005
Q10	200176	TRANS				FAIRCHILD	SE3005
Q11	200176	TRANS				FAIRCHILD	SE3005
Q12	200178	TRANS				FAIRCHILD	2N5910
Q13	200176	TRANS				FAIRCHILD	SE3005
Q14	200176	TRANS				FAIRCHILD	SE3005
Q15	200178	TRANS				FAIRCHILD	2N5910
Q16	200176	TRANS				FAIRCHILD	SE3005
Q17	200176	TRANS				FAIRCHILD	SE3005
Q18	200176	TRANS				FAIRCHILD	SE3005
Q19	200178	TRANS				FAIRCHILD	2N5910

PARTS LIST

ASSEMBLY 403470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION								
Q20	200176	TRANS							FAIRCHILD	SE3005
Q21	200176	TRANS							FAIRCHILD	SE3005
Q22	200178	TRANS							FAIRCHILD	2N5910
Q23	200176	TRANS							FAIRCHILD	SE3005
R01	010727	RES		2.5	K	.01%			VISHAY	V53-3-M
R02	010615	RES		10	K	.02%			VISHAY	V53-1
R03	020628	RES	WW	120.42	K	.02%			JORDAN	J-9D
R04	000100	RES	CARBON	10	OHM	5%	1/4	W	OHMITE	RC07GF100J
R05	020629	RES	WW	438.19	K	.02%			JORDAN	J-11D
R06	010586	RES		5	K	.02%			VISHAY	V53-1-M
R07	010727	RES		2.5	K	.01%			VISHAY	V53-3-M
R08	010615	RES		10	K	.02%			VISHAY	V53-1
R09	000513	RES	CARBON	51	K	5%	1/4	W	OHMITE	RC07GF513J
R10	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R100	010529	RES		10	K	1%			IRC	RN55D
R101	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R102	000303	RES	CARBON	30	K	5%	1/4	W	OHMITE	RC07GF303J
R103	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R104	000510	RES	CARBON	51	OHM	5%	1/4	W	OHMITE	RC07GF510J
R105	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R106	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R107	000161	RES	CARBON	160	OHM	5%	1/4	W	OHMITE	RC07GF161J
R108	000911	RES	CARBON	910	OHM	5%	1/4	W	OHMITE	RC07GF911J
R109	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R11	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R110	000101	RES	CARBON	100	OHM	5%	1/4	W	OHMITE	RC07GF101J
R111	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R112	000200	RES	CARBON	20	OHM	5%	1/4	W	OHMITE	RC07GF200J
R113	000107	RES	CARBON	100	M	5%	1/4	W	OHMITE	RC07GF107J
R114	001737	RES	FSV			5%	1/4	W	DANA	001737
R12	000561	RES	CARBON	560	OHM	5%	1/4	W	OHMITE	RC07GF561J
R13	000242	RES	CARBON	2.4	K	5%	1/4	W	OHMITE	RC07GF242J
R14	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R15	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R16	000621	RES	CARBON	620	OHM	5%	1/4	W	OHMITE	RC07GF621J

PARTS LIST

ASSEMBLY 403470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
R17	000561	RES	CARBON	560 OHM	5%	1/4 W	OHMITE	RC07GF561J
R18	000107	RES	CARBON	100 M	5%	1/4 W	OHMITE	RC07GF107J
R19	000107	RES	CARBON	100 M	5%	1/4 W	OHMITE	RC07GF107J
R20	000107	RES	CARBON	100 M	5%	1/4 W	OHMITE	RC07GF107J
R21	000107	RES	CARBON	100 M	5%	1/4 W	OHMITE	RC07GF107J
R22	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R23	000242	RES	CARBON	2.4 K	5%	1/4 W	OHMITE	RC07GF242J
R24	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R25	000362	RES	CARBON	3.6 K	5%	1/4 W	OHMITE	RC07GF362J
R26	040191	POT	CERMET	1 M			BECKMAN	79P
R27	040112	RES	VARI	2 K			BECKMAN	79PR2K
R29	000100	RES	CARBON	10 OHM	5%	1/4 W	OHMITE	RC07GF100J
R30	040191	POT	CERMET	1 M			BECKMAN	79P
R31	040112	RES	VARI	2 K			BECKMAN	79PR2K
R32	000150	RES	CARBON	15 OHM	5%	1/4 W	OHMITE	RC07GF150J
R34	000100	RES	CARBON	10 OHM	5%	1/4 W	OHMITE	RC07GF100J
R35	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R36	000101	RES	CARBON	100 OHM	5%	1/4 W	OHMITE	RC07GF101J
R37	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R38	000101	RES	CARBON	100 OHM	5%	1/4 W	OHMITE	RC07GF101J
R39	000163	RES	CARBON	16 K	5%	1/4 W	OHMITE	RC07GF163J
R40	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R41	000163	RES	CARBON	16 K	5%	1/4 W	OHMITE	RC07GF163J
R42	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R43	010529	RES		10 K	1%		IRC	RN55D
R44	000151	RES	CARBON	150 OHM	5%	1/4 W	OHMITE	RC07GF151J
R45	010529	RES		10 K	1%		IRC	RN55D
R46	000101	RES	CARBON	100 OHM	5%	1/4 W	OHMITE	RC07GF101J
R47	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R48	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R49	000101	RES	CARBON	100 OHM	5%	1/4 W	OHMITE	RC07GF101J
R50	000510	RES	CARBON	51 OHM	5%	1/4 W	OHMITE	RC07GF510J
R51	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R52	000101	RES	CARBON	100 OHM	5%	1/4 W	OHMITE	RC07GF101J

PARTS LIST

ASSEMBLY 403470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R53	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R54	000510	RES	CARBON	51	OHM	5%	1/4 W	OHMITE	RC07GF510J
R55	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R56	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R57	000161	RES	CARBON	160	OHM	5%	1/4 W	OHMITE	RC07GF161J
R58	000911	RES	CARBON	910	OHM	5%	1/4 W	OHMITE	RC07GF911J
R59	000161	RES	CARBON	160	OHM	5%	1/4 W	OHMITE	RC07GF161J
R60	000911	RES	CARBON	910	OHM	5%	1/4 W	OHMITE	RC07GF911J
R61	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R62	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R63	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R64	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R65	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R66	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R67	010615	RES		10	K	.02%		VISHAY	V53-1
R68	040123	RES	VARI	1	K			BECKMAN	62PRIK
R69	020627	RES	WW	81.73	K	.02%		JORDAN	J-9D
R70	010586	RES		5	K	.02%		VISHAY	V53-1-M
R71	010726	RES	METAL	10.71	K	.1%		IRC	RN55C
R72	010730	RES		5.355	K	.01%		VISHAY	V53-3-M
R73	010729	RES		31.31	K	.02%		VISHAY	V53-3-M
R74	040191	POT	CERMET	1	M			BECKMAN	79P
R75	000107	RES	CARBON	100	M	5%	1/4 W	OHMITE	RC07GF107J
R76	000107	RES	CARBON	100	M	5%	1/4 W	OHMITE	RC07GF107J
R77	000392	RES	CARBON	0003.9	K	5%	1/4 W	OHMITE	RC07GF392J
R78	010728	RES		33.91	K	.02%		VISHAY	V53-3-M
R79	010615	RES		10	K	.02%		VISHAY	V53-1
R80	000561	RES	CARBON	560	OHM	5%	1/4 W	OHMITE	RC07GF561J
R81	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R82	010737	RES	METAL	10.01	K			VISHAY	V53-1M
R83	040191	POT	CERMET	1	M			BECKMAN	79P
R84	000100	RES	CARBON	10	OHM	5%	1/4 W	OHMITE	RC07GF100J
R85	000561	RES	CARBON	560	OHM	5%	1/4 W	OHMITE	RC07GF561J
R86	000390	RES	CARBON	39	OHM	5%	1/4 W	OHMITE	RC07GF390J
R87	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403470 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R88	000107	RES	CARBON	100	M	5%	1/4 W	OHMITE	RC07GF107J
R89	000107	RES	CARBON	100	M	5%	1/4 W	OHMITE	RC07GF107J
R90	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R91	000362	RES	CARBON	3.6	K	5%	1/4 W	OHMITE	RC07GF362J
R92	040191	POT	CERMET	1	M			BECKMAN	79P
R93	040112	RES	VARI	2	K			BECKMAN	79PR2K
R94	000150	RES	CARBON	15	OHM	5%	1/4 W	OHMITE	RC07GF150J
R95	000100	RES	CARBON	10	OHM	5%	1/4 W	OHMITE	RC07GF100J
R96	000303	RES	CARBON	30	K	5%	1/4 W	OHMITE	RC07GF303J
R97	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R98	000163	RES	CARBON	16	K	5%	1/4 W	OHMITE	RC07GF163J
R99	000303	RES	CARBON	30	K	5%	1/4 W	OHMITE	RC07GF303J
W01	600245	JUMPER						GETTIG	L-2007-1
W02	600245	JUMPER						GETTIG	L-2007-1
R115	001737	RES	FSV			5%	1/4 W	DANA	001737
R116	000151	RES	CARBON	150	OHM	5%	1/4 W	OHMITE	RC07GF151J
R117	000151	RES	CARBON	150	OHM	5%	1/4 W	OHMITE	RC07GF151J
C62	100084	CAP	CERAM	1.5	PFD	1 KV		SPRAGUE	10TCC-V15
C63	100084	CAP	CERAM	1.5	PFD	1 KV		SPRAGUE	10TCC-V15
C64	100086	CAP	CERAM	0.04	MFD	20%	500 V	SPRAGUE	44C124A

PARTS LIST

ASSEMBLY 403472 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
CR01	211083	DIODE SILICO	018				DANA	211083
CR02	211083	DIODE SILICO	018				DANA	211083
CR03	210035	DIODE	HP5082				HP	HP5082-2810
CR04	210035	DIODE	HP5082				HP	HP5082-2810
CR06	211083	DIODE SILICO	018				DANA	211083
CR07	211083	DIODE SILICO	018				DANA	211083
CR08	211083	DIODE SILICO	018				DANA	211083
CR09	220007	DIODE SILICO	ZENER 1N751				MOTOROLA	1N751
CR10	211083	DIODE SILICO	018				DANA	211083
CR11	211083	DIODE SILICO	018				DANA	211083
CR12	211083	DIODE SILICO	018				DANA	211083
C01	130116	CAP MICA	4000 PFD	500 V	2%		ELMENCO	DM19
C02	120275	CAP POLY	1000 PFD	630 V	2.5%		NPC	KSO Series
C03	130115	CAP MICA	346 PFD	500 V	2%		ELMENCO	DM15
C04	120274	CAP POLY	87 PFD	630 V	2.5%		NPC	KSO Series
C05	100074	CAP	5 PFD	1 KV			SPRAGUE	10TCCV50
C06	100075	CAP CERAM	10 PFD	1 KV	2%		SPRAGUE	10TCCQ10
C07	130124	CAP CERAM	10 PFD	250 V			S-T	R-TR1K0-122-09SD
C08	100076	CAP	20 PFD	1 KV			SPRAGUE	10TCCQ20
C09	130123	CAP CERAM	3 PFD	250 V			S-T	R-TR1K0-122-09SD
C10	100050	CAP					SPRAGUE	10TCC-V22
C11	100061	CAP DISC	39 PFD	1000 V	5%		SPRAGUE	10TCC-Q39
C12	100077	CAP	7.5 PFD	500 V	5%		VITRAMON	VY10CA7R5JA
C13	100075	CAP CERAM	10 PFD	1 KV			SPRAGUE	10TCCQ10
C14	100075	CAP CERAM	10 PFD	1 KV			SPRAGUE	10TCCQ10
C15	100077	CAP	7.5 PFD	500 V	5%		VITRAMON	VY10CA7R5JA
C16	130125	CAP	10 PFD	250 V			JOHANSON	JMC2951
C17	130125	CAP	10 PFD	250 V			JOHANSON	JMC2951
C18	120090	CAP MYLAR	.22 MFD	600 V	20%		IMB	ZA1101
C19	110126	CAP TANTA	6.8 MFD	35 V			ITT	4312 17168
C20	130127	CAP	40 PFD				S-T	10S-TR1K0-24N750
C23	110126	CAP TANTA	6.8 MFD	35 V			ITT	4312 17168
C25	110140	CAP TANTA	47 MFD	6.3 V			ITT	4-3212-12247

PARTS LIST

ASSEMBLY 403472 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
C26	110126	CAP	TANTA	6.8 MFD	35 V		ITT	4312 17168
C27	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C28	100079	CAP		3.9 PFD			SPRAGUE	10TCCV39
C29	100100	CAP	CERAM	FSV				
C31	101174	CAP	CERAM	.001 MFD	500 V	10%	AERCVCX	SCD3X5F
C32	110126	CAP	TANTA	6.8 MFD	35 V		ITT	4312 17168
C33	101174	CAP	CERAM	.001 MFD	500 V	10%	AERCVCX	SCD3X5F
K01	310078	REED RELAY, SHIELD					ELECTROL	R2690-3
K02	310077	REED RELAY, SHIELD					ELECTROL	R2691-3
K03	310078	REED RELAY, SHIELD					ELECTROL	R2690-3
L01	310068	CHOKE		1 UH			DELEVAN	1537-12
Q01	200176	TRANS					FAIRCHILD	SE3005
Q02	200161	DUAL FET					LEDEL	LS3954
Q03	200176	TRANS					FAIRCHILD	SE3005
Q04	200176	TRANS					FAIRCHILD	SE3005
Q05	200176	TRANS					FAIRCHILD	SE3005
Q06	200176	TRANS					FAIRCHILD	SE3005
Q07	200176	TRANS					FAIRCHILD	SE3005
Q08	200176	TRANS					FAIRCHILD	SE3005
R01	010721	RES		MATCHED SET			IRC	RN75
R02	010720	RES	METAL	9.09 K		.25%	IRC	RN55C
R03	040195	POT		500 OHM			BECKMAN	79PR500
R04	010721	RES		MATCHED SET			IRC	RN75
R05	040176	POT	CERMET	50 OHM			BECKMAN	79PR50
R06	010721	RES		MATCHED SET			IRC	RN75
R07	040195	POT		500 OHM			BECKMAN	79PR500
R08	010721	RES		MATCHED SET			IRC	RN75
R09	010721	RES		MATCHED SET			IRC	RN75
R10	041179	POT		5 K			SPECTROL	50-1-1-502
R11	000163	RES	CARBON	16 K	5%	1/4 W	OHMITE	RC07GF163J
R12	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R13	000510	RES	CARBON	51 OHM	5%	1/4 W	OHMITE	RC07GF510J
R14	000241	RES	CARBON	240 OHM	5%	1/4 W	OHMITE	RC07GF241J
R15	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R16	010718	RES		237 OHM	1%		IRC	RN55D

PARTS LIST

ASSEMBLY 403472 - Model 4800

REF. DESIG.	PART NO.	DESCRIPTION							
R17	000822	RES	CARBON	8.2 K	5%	1/4 W		OHMITE	RC07GF822J
R18	000241	RES	CARBON	240 OHM	5%	1/4 W		OHMITE	RC07GF241J
R19	010719	RES		16.2 K	1%			IRC	RN55D
R20	010718	RES		237 OHM	1%			IRC	RN55D
R21	000510	RES	CARBON	51 OHM	5%	1/4 W		OHMITE	RC07GF510J
R22	000101	RES	CARBON	100 OHM	5%	1/4 W		OHMITE	RC07GF101J
R23	000183	RES	CARBON	18 K	5%	1/4 W		OHMITE	RC07GF183J
R24	000183	RES	CARBON	18 K	5%	1/4 W		OHMITE	RC07GF183J
R25	000102	RES	CARBON	1 K	5%	1/4 W		OHMITE	RC07GF102J
R26	000183	RES	CARBON	18 K	5%	1/4 W		OHMITE	RC07GF183J
R27	000432	RES	CARBON	4.3 K	5%	1/4 W		OHMITE	RC07GF432J
R28	000510	RES	CARBON	51 OHM	5%	1/4 W		OHMITE	RC07GF510J
R29	000160	RES	CARBON	16 OHM	5%	1/4 W		OHMITE	RC07GF160J
R31	001469	RES	CARBON	1.2 K	5%	1/2 W		OHMITE	RC20GF122J
R32	000474	RES	CARBON	470 K	5%	1/4 W		OHMITE	RC07GF474J
CR13	220012	DIODE SLCO ZENER 1N958B						MOTOROLA	1N958B
C34	110140	CAP	TANTA	47 MFD	6.3 V			ITT	43212-12247
C35	110140	CAP	TANTA	47 MFD	6.3 V			ITT	43212-12247
C36	110140	CAP	TANTA	47 MFD	6.3 V			ITT	43212-12247
C37	110141	CAP		22 MFD	16 V			ITT	43212-14222
C38	100012	CAP	CERAM	33 PFD	500 V		10%	AEROVOX	TCD-N750

PARTS LIST

ASSEMBLY 403436 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION						
CR01	211083	DIODE SILICO	018				DANA	211083
CR02	211083	DIODE SILICO	018				DANA	211083
CR03	211083	DIODE SILICO	018				DANA	211083
CR04	211083	DIODE SILICO	018				DANA	211083
CR05	211083	DIODE SILICO	018				DANA	211083
CR06	211083	DIODE SILICO	018				DANA	211083
CR07	211083	DIODE SILICO	018				DANA	211083
CR08	211083	DIODE SILICO	018				DANA	211083
CR09	211083	DIODE SILICO	018				DANA	211083
C01	101099	CAP CERAM	680 PFD	500 V	10%		AERCVCX	SCD2X5F
C02	110149	CAP TANTA	.39 MFD	50 V	10%		KEMET	KR39W50K
C03	110148	CAP TANTA	.22 MFD	50 V	10%		KEMET	KR22W50K
C04	110147	CAP TANTA	.18 MFD	50 V	10%		KEMET	KR18W50K
C05	121468	CAP MYLAR	.022 MFD	100 V	10%		CDE	WMF1S22
C06	100017	CAP CERAM	.01 MFD	200 V	10%		SPRAGUE	TH-S10
C07	100017	CAP CERAM	.01 MFD	200 V	10%		SPRAGUE	TH-S10
J03	920460	INTEGRATED CIRCUIT					AUGAT	314AG5D-2R
J04	920463	FUSE CLIP					AUGAT	600832AT
M01	230029	INTEGRATED CIRCUIT					TI	SN7401N
M02	230029	INTEGRATED CIRCUIT					TI	SN7401N
M03	230029	INTEGRATED CIRCUIT					TI	SN7401N
M04	230064	INTEGRATED CIRCUIT					TI	SN7404N
M05	230064	INTEGRATED CIRCUIT					TI	SN7404N
M06	230073	INTEGRATED CIRCUIT					LIBERTY	SN7405N
M07	230028	INTEGRATED CIRCUIT					TI	SN7400N
M08	230032	INTEGRATED CIRCUIT					TI	SN7420N
M09	230030	INTEGRATED CIRCUIT					TI	SN7402N
M10	230029	INTEGRATED CIRCUIT					TI	SN7401N
Q01	200037	TRANS SILICO NPN	2N3646				FAIRCHILD	2N3646
Q02	200136	TRANS					FAIRCHILD	SE4022
Q03	200136	TRANS					FAIRCHILD	SE4022
Q04	200136	TRANS					FAIRCHILD	SE4022
Q05	200136	TRANS					FAIRCHILD	SE4022
Q06	200136	TRANS					FAIRCHILD	SE4022
Q07	200088	TRANS SILICO PNP	2N4248				FAIRCHILD	2N4248

PARTS LIST

ASSEMBLY 403436 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
Q08	200037	TRANS SILICO NPN			2N3646			FAIRCHILD	2N3646
R01	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R02	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R03	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R04	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R05	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R06	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R07	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R08	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R09	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R10	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R11	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R12	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R13	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R14	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R15	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R16	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R17	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R18	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R19	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R20	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R21	000392	RES	CARBON	0003.9	K	5%	1/4 W	OHMITE	RC07GF392J
R22	000432	RES	CARBON	4.3	K	5%	1/4 W	OHMITE	RC07GF432J
R23	000432	RES	CARBON	4.3	K	5%	1/4 W	OHMITE	RC07GF432J
R24	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R25	000105	RES	CARBON	1	M	5%	1/4 W	OHMITE	RC07GF105J
R26	010676	RES	METAL	15	K	1%		IRC	RN55C
R27	010529	RES		10	K	1%		IRC	RN55D
R28	000105	RES	CARBON	1	M	5%	1/4 W	OHMITE	RC07GF105J
R29	010697	RES	METAL	26.7	K	1%		IRC	RN55D
R30	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R31	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R32	000242	RES	CARBON	2.4	K	5%	1/4 W	OHMITE	RC07GF242J
R33	000432	RES	CARBON	4.3	K	5%	1/4 W	OHMITE	RC07GF432J
R34	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403436 - Model 4800 A

REF. DESIG.	PART NO.	DESCRIPTION							
R35	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R36	000123	RES	CARBON	12 K	5%	1/4 W	OHMITE	RC07GF123J

DANA.

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